



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

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1. INTRODUCTION

Background of the Study

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]

HCW can have a long-term impact on public health as well as the health of those who handle, collect, and recycle trash. Additionally, the burning of surface garbage or untreated medical waste pollution are contaminating fresh water supplies and soil, harming the natural environment. [35-39] In addition to preventing environmental pollution, safe management of healthcare waste aims to minimize and reduce the health hazards associated with getting direct contact with infectious and dangerous elements in the waste. [33]

Various laws and rules govern the management of hospital wastes in the Philippines. Hospitals are particularly bound by the rules outlined in the Department of Health's 2005 Revised Health Care Waste Management Manual (RHCWWM), in addition to the basic guidelines that apply to all organizations. [41] However, the sciences of medicine are evolving more quickly than waste management techniques. [17] 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. Therefore, the hospital infection control staff must establish rules and regulations and then appropriately and promptly remind people of the significance of following them. [19]

This study aims to identify the perception of the healthcare workers from public hospitals across the Philippines regarding healthcare waste management practices and associated risk factors. The results of this study will serve as an overview about the existence of healthcare waste management practices among public hospitals across the Philippines and the adherence to the laws and legislations that govern this matter. It will also aid in the enhancement of healthcare waste management practices, promote occupational safety, and encourage the establishment of sustainable healthcare systems.

Review of Related Literature

In the course of this research, various information sources related to hospital waste management, the issues associated with it, and the awareness of hospital workers have been thoroughly reviewed. These resources encompass a range of materials, including reports on Healthcare Waste Management (HWM), research papers published in diverse journals and publications.

In a study in Ethiopia, the significance of healthcare waste management becomes evident. Only 29.3% of the participants, according to their research, demonstrated appropriate healthcare waste management techniques. Compared to a similar study conducted in Bangladesh, where about 45% of healthcare personnel correctly performed healthcare waste management, this ratio is noticeably lower. Additionally, it is not up to the standards set by the Ludhiana Hospital in India, which recorded a 59.1% safe practice rate in the handling of biomedical waste (BMW). [34]

With over 3.7 million cases reported to date, the Philippines is among the worst-hit countries in the world and Southeast Asia following the recent pandemic. [54-56]. Thus, in addition to the above data, the nation has also seen a dramatic increase in waste produced in both home and healthcare settings. [57] In the National Capital Region, healthcare facilities had been estimated to produce only 47 metric tons of medical waste daily during the pre-pandemic period where 56% around 26 tons of this was considered potentially infectious. [59]

The Hospital Licensure Act (RA 4226), the Code of Sanitation of the Philippines (PD 856), and the Toxic Substances, Hazardous, and Nuclear Waste Control Act of 1990 (RA 6969) are among the laws that govern the management of various types of healthcare wastes, including infectious waste, sharps, pharmaceutical wastes, genotoxic wastes, chemical wastes, and radioactive wastes, among other typologies. These laws are consolidated and operationalized in the Department of Health's (DOH) Revised Health Care Waste Management Manual (2005). [3] However, the fact whether a law exists does not guarantee that it is adequate or comprehensive, nor does it guarantee that it is enforced and followed. [58]

Healthcare Wastes

Healthcare waste (HCW) and/or wastes created by health service delivery facilities and laboratories are the terms most frequently used to characterize waste generated by healthcare facilities. [1,2] Other words like clinical trash, biomedical waste, medical waste, and waste from health facilities are also used. [1] Additionally, HCW encompasses the same kinds of waste from small and dispersed sources, like waste generated during home health care activities like insulin self-administration, home dialysis, and recuperative care. [3] The majority of these are hazardous, poisonous, infectious, and carcinogenic materials. [4] The non-hazardous wastes characterized as domestic wastes such as paper, kitchen wastes that comprise between 75% and 80% of the HCW on health facilities. The upkeep of healthcare facilities as well as administrative and housekeeping tasks are the main sources of these wastes. While 15% to 20% of all garbage generated at healthcare facilities is classified as hazardous waste because it contains materials that pose a health risk, such as needles, sharps, and infectious bodily fluids. Moreover, 15% of the most dangerous wastes are infectious and pathological wastes, [5,14,18,52], wherein 3% are from chemicals and pharmaceuticals, and 1% from sharps and radioactive or genotoxic wastes. [5]

HCW may be classified as miscellaneous wastes (Class M) under the hazardous waste classification scheme, which designates pharmaceuticals and drugs as waste number M503 and pathological or infectious wastes as M501. [3,6] Sharps and other medical trash as well as pathological, pathogenic, and infectious wastes are included in the M501 healthcare waste that comes from hospitals, clinics, and medical facilities. Pharmaceutical and drug waste (M503) refers to expired pharmaceuticals and drugs that are kept in stock at the premises of manufacturers and retailers. These materials may contain environmentally dangerous ingredients including antibiotics, veterinary and phytopharmaceuticals, and others. [3]

The rate at which healthcare waste is produced varies greatly among nations and is influenced by a variety of factors, such as waste management strategies, the nature of healthcare facilities and specializations, the quantity of reusable equipment kept on hand, and the daily patient volume. [7] Additionally, the general makeup of its healthcare wastes is determined by the health care activities. [3]

Healthcare Facilities and Healthcare Waste Management

All officially recognized establishments that offer health care are included in the term "health care facilities," including public and private (including faith-run) primary (health posts and clinics), secondary, and tertiary (district or national hospitals), as well as transitory buildings made for emergency situations (e.g., cholera treatment centers). They could be found in rural or urban settings. [8] Healthcare facilities (HCFs) are the primary producers of healthcare waste. Variations in waste generation based on its volume or kind, or between rural and urban HCFs, may be attributed to variations in the services offered, the size of the organization, the organizational complexity, the resources available, and the number of medical and other staff members. [1,3] Waste production in public hospitals was found to be higher than in private hospitals. [9]

The difference in healthcare waste management techniques between private and public hospitals was another important discovery. Compared to public hospitals (53.5%), private hospitals showed greater compliance rates (79.2%). This variance could be attributed to factors such as the business-oriented nature of private hospitals, their need to maintain a clean and appealing environment to attract clients, and a higher standard of equipment. Better healthcare waste management practices were also substantially correlated with the presence of healthcare waste management committees and the availability of manuals and guidelines. Both public and private hospitals consistently recognized the value of these services and resources, highlighting the necessity of advice and information sharing in the context of healthcare waste management. [10]

Healthcare Waste Management Practices

A country's health care system must include the management of medical waste. Nonetheless, it was shown that between 20% and 60% of medical facilities in 22 developing nations in the Western Pacific Region lack appropriate systems for managing medical waste, which include effective waste segregation at the source, storage, collection, transportation, treatment, and disposal. [11,12] The Philippines is certainly one of the nations that make up the West Pacific region. Negligent waste management can be a major environmental hazard as well as a source of re-infection and long-term, undesired health hazards for the population. As a result, HCW management calls for extra attention and ought to be given top priority. [13] Waste segregation procedures

ought to be standardized nationwide and included into national rules for HCW management in compliance with WHO guidelines. [14] In addition, the population of low- and middle-income countries (LMICs) is expanding at a rapid pace, which is driving up the demand for medical services and increasing the amount of medical waste (MW) produced by this expansion. [50,51,52].

The waste management team, effective administration and organization, meticulous planning, legal frameworks, adequate funding, and the full involvement of trained staff in this process are all necessary for the proper treatment of medical waste in HCFs. Safe HCW management procedures involve all aspects of waste creation, segregation, transportation, storage, treatment, and disposal. They also have an impact on the quality of HCF services. [15,16] Managers of healthcare institutions are in charge of implementing and maintaining an acceptable waste management system and monitoring all medical staff members' adherence to it. Therefore, all employees who are accountable for and involved in the trash collection and segregation procedures must have access to the proper education and training programs.[23]

Just 141 (53.4%) of the 264 research participants consistently wore gloves when working with HCW. Most healthcare professionals (64.8%) fill the safety boxes more than the advised or recommended level. Approximately 90% of those handling HCW were dressed in an apron or gown. Nonetheless, almost half of the participants (49%) filled the infectious safety box more than 75%. Comparably, 45 percent or so of the research participants lacked any criteria endorsing the HCWM practice. When handling healthcare workers, 118 (68.6%) of the respondents said they wore gloves. Of the responders, 41 (15.5%) have used improper disinfection methods on reusable products. Of the respondents, 277 (78.4%) placed HCW in approved containers. Merely 58 healthcare professionals, or 22% of the total, covered the waste container when transporting HCW to final disposal sites. [46]

Risk Perception and Training on Healthcare Waste Management

People who handle medical waste, work in healthcare institutions, are in close proximity to dangerous medical waste, or are exposed due to negligence are all possibly at risk. Physicians, nurses, healthcare support personnel, patients, HCF visitors, and support service employees—such as laundry personnel, waste management and transportation staff, and employees of waste disposal facilities—are the primary risk groups. [18] HCW management issues are more common in poorer nations that generate hundreds of tons of garbage every day. According to studies conducted in Ethiopia, 35 percent of medical facilities gather and discard needles, syringes, and other sharp objects in a way that continuously increases the danger of exposure and harm to both the general public and medical staff. [36] Human health and life are seriously threatened by HCW, particularly in low- and middle-income nations. An estimated 5.2 million people globally, including 4 million children, pass away every year as a result of illnesses brought on by improperly managed medical waste. [20]

Healthcare personnel in government hospitals were more familiar with the healthcare waste disposal system (81.5%) than in private hospitals (57.3%), and more government hospital staff had received training on it. [21] Additional issues include inadequate human resources, inadequate training in proper waste management, a lack of understanding of health risks linked with healthcare workers, and a low priority that increases the danger to healthcare waste management. [25] In public hospitals in the South West Region of Ethiopia, the overall prevalence of excellent waste handling procedures among healthcare waste handlers was 47.3%. [17]

According to studies, workers who handle medical waste and are well-versed in safe waste handling and waste management follow safer work practices. [22,24] Predicted knowledge and practice were HCW management posters and training. Thus, in order to guarantee proper understanding and practice of safe health care waste management in healthcare facilities and lower the risk of infections and injuries to staff members and the general public, frequent training, supervision, and the display of educational posters are essential. [26]

304 (84.9%) of the study's total respondents were aware that diseases might spread through incorrect handling of medical waste. PPE was used by nearly all (98%) of the respondents when working with HCW. The percentage of respondents who knew about appropriate accident and injury reporting systems, had received a hepatitis B vaccination, and were aware of general precautions was 80.7%, 75.1%, and 76.5%, respectively. Only 57% of the color-coded containers were available in the respondents' wards out of the total 216 (60.3%) respondents who worked eight hours a day; nevertheless, 70.9% of respondents had access to HCWM rules and policies. Merely 28.8% of the participants reported having obtained training in HCWM. [34]

According to earlier research, healthcare waste handlers who were well-versed in safe waste handling and healthcare waste management had superior workplace safety procedures. [22, 44] The likelihood of safe procedures among waste handlers who had sufficient supplies was 3.45 times higher than that of those who had inadequate supplies. [23]

The majority of responders (83%) stated that there is a higher danger of injury when waste containers are not properly colored coded. Health workers should not be separated at the site of waste generation, according to more than half (52.3%) of respondents who work in private health institutions. Among health professionals, one in five (19.3%) said that the safety box has to be filled beyond what was recommended. It was discovered that 178 (67.4%) healthcare personnel had a good comprehension of HCWM practices using the knowledge-based questions designed to gauge their level of knowledge. [47]

Healthcare professionals who were well-versed in HCWM were approximately five times more likely to practice good HCWM than those who were not. This result is in line with a study carried out in Gondar, which found that appropriate waste management is influenced by HCWM knowledge. This may be the result of more skilled healthcare professionals practicing waste segregation, which improves excellent practice and determines the waste disposal system. [47]

47.7% and 42.3%, respectively, of survey participants reported having adequate knowledge and practicing healthcare waste management. However, the only factor that was substantially correlated with practice was educational status. The healthcare personnel in this study have inadequate knowledge and practice about healthcare waste management. [48]

One hundred thirty-eight (53.1%) of the healthcare workers did not receive any training on healthcare waste management, and two hundred fifty-two (96.9%) did not have access to any guidelines. 65 people, or 25% of the population, reported having had a needle stick or other sharp injury in the year prior. Six (9.6%) of these injuries happened while handling medical waste. According to 109 respondents, or 49.1%, there were no safety instructions at their place of work. Even after multivariate analysis was performed, training on healthcare waste continued to be strongly correlated with healthcare waste management practices. Compared to their colleagues who did not receive training on healthcare waste management, healthcare workers who did receive such training were 2.29 times more likely to undertake healthcare waste management. [49]

The most frequent issues relating to health-care waste are not enough knowledge of the risks to one's health posed by such waste, inadequate training in appropriate waste management, lack of systems for managing and disposing of waste, inadequate financial and human resources, and low priority placed on the issue. Many nations either lack the necessary regulations or do not uphold them. [50]

Despite knowing what healthcare waste management (HCWM) was, a sizable portion of healthcare professionals (50.2%) did not conduct appropriate HCWM. This could have been due to a number of factors, including low educational attainment, inadequate training, or disregard for HCWM guidelines. [46]

The actual practice and adherence to good health care waste management (HCWM) depend heavily on knowledge and understanding of the subject. 60% of participants in the study at Sub-Saharan African nations adhered to appropriate HCWM. [48]

Socio-demographics of Healthcare Workers and Risks to Healthcare Waste

Healthcare professionals with over ten years of work experience had a greater understanding of biomedical waste management. [27] In one study, it was shown that participants' age had a substantial impact on how likely they were to use safety precautions; those under the age of 25 were 7.46 times more likely to do so than those in older age groups. [23] Age (30–45), experience (10 years or more), and work in the lab/emergency department and maternity were the criteria linked to a greater rating of having sufficient knowledge. [28] There was a higher likelihood of satisfactory HCW management practices among health workers with diploma education working in the adolescent corner, those who had received prior training on HCW management, and those who believed HCW management was important. [13]

Because education gives basic knowledge about the work environment, and because only educational status was strongly connected with healthcare waste practice, workers' ability to adapt to their work environment and operate in a safe manner is greatly influenced by their degree of education. [23,29]

The expertise of medical laboratory personnel, nurses, midwives, and health professionals in the 35–44 age range was substantially correlated with it. [29]

One hundred fifty-three or 58.8% of the 260 HCWs who took part in one of the studies were men. Of the total number of people, 203 or 78.1% were Orthodox Christians and 122 or 58.5% were single. Most of the responders (144, 55.4%) were nurses, 58, 22.3% worked in a medical ward, and 108, 41.5% had been employed for one to five years. Twenty or 7.7% of the participants worked in clinics, whereas 195 or 95.0% of the participants were employed in hospitals. [49]

In a different study, nurses were found 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. Sixty-three percent of the respondents were in the 20–30 age range, and most of the respondents who adhered to HCWM highly were also in this age range. 53% of those surveyed had between one and five years of experience. Women made up 59% of the study's responses. This is consistent with research on the factors 66 impacting healthcare workers' adherence to appropriate HCWM practices conducted in Uganda, where 58.8% of the participants were female. [48]

Conceptual Framework

The schematic diagram below illustrates the connection between participants' socio-demographic profile and their attitudes and perspectives towards healthcare waste management practices. It also highlights the potential risks associated with improper healthcare waste management practices. The diagram shows that factors such as age, sex, length of service, employment status, designation, educational attainment, and attendance to training or orientation on healthcare waste and associated risk factors can influence individuals' perspectives towards waste management practices. These socio-demographic factors interact with one another and shape how individuals approach and engage in waste management practices such as waste reduction/minimization, waste identification, waste segregation, and waste disposal practices. It is important to consider these factors when designing waste management strategies to ensure they are responsive to the needs and circumstances of different populations. By understanding the relationship between socio-demographic factors and attitudes, efforts can be made to promote responsible waste management practices and mitigate the potential risks posed by improper waste disposal.

This study employs the Health Belief Model, which presumes that people's beliefs on the gravity of a health issue, their vulnerability to the issue, the advantages of acting, and the obstacles to acting all have an impact on their behavior (Rosenstock, 1974). By using the Health Belief Model, this study will investigate the opinions of medical professionals regarding the seriousness of the threats to public health and the environment posed by subpar waste management procedures in public hospitals.

Independent Variables

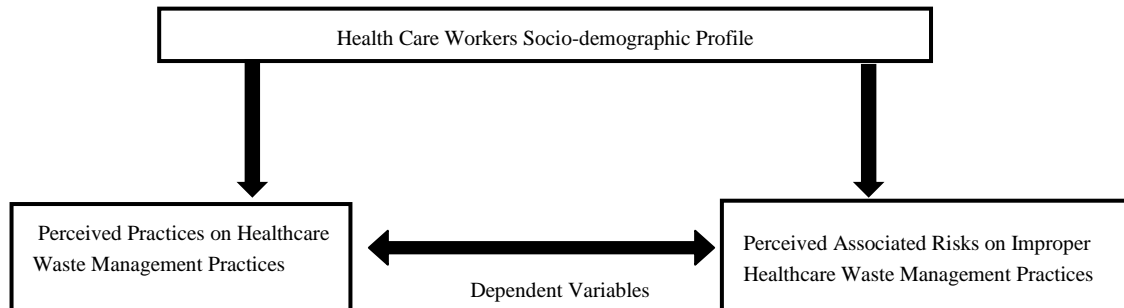


Fig. 1. Schematic diagram showing the relationship of the participants' socio-demographic profile to their attitudes and perceptions on healthcare waste management practices and associated risks on improper healthcare waste management practices.

Statement of the Problem

The study aimed to determine healthcare waste (HCW) management and its associated risk factors among healthcare workers (HCW) of public hospitals in the Philippines.

The above cited problem, answered the following:

1. What are the socio - demographic profiles of healthcare workers (HCW) in terms of the following?
 - 1.1. Age
 - 1.2. Gender
 - 1.3. Length of Service
 - 1.4. Employment status (Permanent, Job Order/ Contract of Service)
 - 1.5. Designation
 - 1.6. Educational Attainment
 - 1.7. Attendance to training or orientation on HCW management and associated risk factors?
2. What are the level of perceived practices of the HCWs on the Healthcare Waste Management of the Public Hospitals in the Philippines in terms of:
 - 2.1. Waste Reduction/ Minimization
 - 2.2. Waste Identification
 - 2.3. Waste Segregation
 - 2.4. Waste Disposal?
3. What are the level of perceived associated risk factors of HCW among healthcare workers of public hospitals in the Philippines in terms of:
 - 3.1 Waste Reduction/ Minimization
 - 3.2 Waste Identification
 - 3.3 Waste Segregation and
 - 3.4 Waste Disposal?
4. Is there a significant relationship between the level of perceived HCWM practices and associated risk factors among Healthcare Workers of public hospitals in the Philippines?

5. Is there a significant relationship between the socio-demographic data to the level of perceived HCWM practices and associated risk factors among Healthcare Workers of public hospitals in the Philippines?

Operational Definitions

Hazardous waste	Associated with some health risks such as sharps, needles, infectious body fluids, etc which makes up 15-20% of the total health facility waste
Healthcare waste management (HCWM)	The process of dealing with or controlling wastes generated from the public hospitals including subsystems such as reduction/ minimization, identification, segregation and disposal.
Healthcare Workers	Encompass the clinical staff (physicians, nurses, allied medical staff) and the administrative staff coming from public hospitals of the Philippines
Healthcare waste (HCW)	Non-hazardous and hazardous wastes from the hospitals
Hospitals	Institutions providing health-related concerns and nursing care for sick or injured people.
Non-hazardous waste	Same with domestic wastes such as paper, kitchen wastes, etc. which is according to WHO comprises 75%-80% of the HCW on health facilities
Public Hospital	Infirmaries and level 1 to 2 hospitals run by the government coming from the regions in Luzon, Visayas and Mindanao
Waste disposal	The step or subsystem of healthcare waste management pertaining to collection, processing, and recycling or deposition of the waste materials
Waste identification	The step or subsystem of healthcare waste management pertaining to familiarization and classification of different types of waste materials
Waste reduction/ minimization	The step or subsystem of healthcare waste management pertaining to the practice or process of using less material to minimize waste generation
Waste segregation	The step or subsystem of healthcare waste management pertaining the sorting and separation of waste types to facilitate recycling and eventual disposal or treatment

Significance of the Study

This research holds immense significance as it aims to contribute towards improving healthcare waste management practices in public hospitals across the Philippines. The study's findings will play a crucial role in enhancing occupational safety, protecting the well-being of healthcare professionals, reducing the environmental impact of healthcare waste, and promoting sustainable healthcare systems. Furthermore, the study's insights will be of great value to policymakers, hospital administrators, waste management agencies be it government (DENR, Environmental Management Bureau) or non-government organizations and healthcare workers, who can use them to implement effective strategies for managing healthcare waste.

Scope and Limitations of the Study

For this study, it was important to note that the findings 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 because of the limited participants.

2. METHODOLOGY

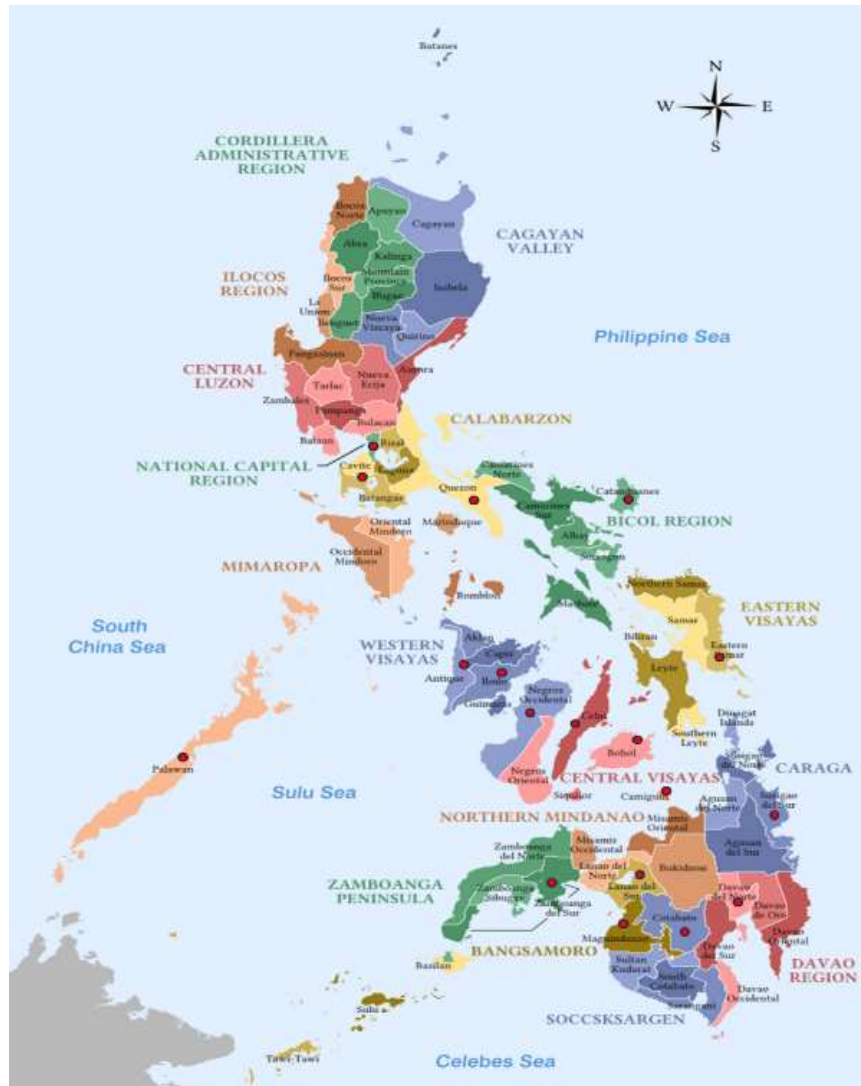
This chapter presents the study design, data collection procedure, data analysis, and ethical consideration.

Study Design

This research utilized a cross-sectional study design encompassing data collection from healthcare workers from public hospitals situated in various regions of the Philippines. This hospital-based survey took place between October and November 2023.

Research Locale

The study was conducted from public hospitals throughout the Philippines which included regions coming from Luzon, Visayas and Mindanao and these served as the locale of the study.



Participants

The study employed a non-probability sampling technique known as convenience sampling. Participants were chosen based on those who were easy for the researcher to reach and get in touch with. This method can be a quick, cost-effective and time-efficient data collection. This can save time and money by picking readily available participants instead of employing more elaborate sampling procedures.

Since the population target was unknown, based on the Raosoft sample size calculator the recommended sample size for this study was 323 however, only 226 responses were 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.

Participants opted not to participate while the data collection was not included in the study.

Research Instruments

Questionnaires were distributed to healthcare workers online using the Google Form and/or in-person based on proximity of the researchers, and data collection took place from October to November 2023 to the healthcare workers. The questionnaire was adapted from the WHO recommendation assessment tool and DOH Health Care Waste Management Manual Fourth Edition 2020.

The questionnaires included questions and statements related to the perceived risk factors and potential health risks associated with improper waste management. The survey-questionnaire comprised four parts: (a) gathering socio-demographic information about the participants; (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 health care professionals as well as their recommendations for improvements on healthcare waste management in their respective workplaces.

The researchers conducted the pilot testing prior to the distribution of the questionnaire to the participants to test its reliability and validity. In this context, Cronbach's α (alpha) value like 0.980 signified an exceptionally high degree of uniformity and dependability in the measurement of the intended concept, indicating that the scale is a highly reliable instrument for assessing the desired construct.

Data Collection

The researchers obtained permission from each Chief of Hospitals for the in-person participants while an informed consent in the Google form was administered for the online-survey of the study. Once approval was granted by the Chief of Hospital's office, questionnaires were distributed to the healthcare workers, with collection taking place a week later. The retrieval of the survey instrument will be conducted without encountering any difficulties.

Following data collection, the researcher proceeded to tally, analyze, and interpret the data using a statistical process based on the study's problem statement.

Scope and Limitations of the Study

The study focuses on the current practices of hospital waste management practices of public hospitals of the Philippines, as perceived by healthcare workers.

Perceptions on healthcare waste management practices and its associated risk factors serve as independent variables for the study. In contrast, the socio-demographic profiles such as: age, gender, work experience, employment status, job description, educational attainment, and attendance to training or orientation on HCW management of the participants serve as dependent variables.

The participants included hospital personnel, such as doctors, nurses, paramedical staff, utilities, security guards, and staff from the kitchen, laundry, and ambulance services. The primary source of data was firsthand information provided by the participants through the survey-questionnaire instrument. Secondary data will be obtained from published books, journals, and online sources.

Data Analysis

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 will be employed to gain insight into relationships, and regression analysis will be used to determine the significance of variables, thereby revealing connections between demographic profiles and perceptions. The data were analyzed using Jamovi version 2.4.11. Jamovi is an open-source statistical software that serves as a user-friendly and cost-effective alternative to more expensive statistical products like SPSS and SAS. It is designed to simplify and streamline the process of statistical analysis by providing a visual and intuitive interface. Built on top of the R statistical language, Jamovi offers access to a wide range of statistical techniques and analysis tools. [60,61]

Ethical Considerations

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.

RESULTS AND DISCUSSION

Socio-Demographic Profile of the 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 the same 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 workers, categorized by contractual arrangements, 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 was also 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.*

N = 226		
Socio-Demographic Profile	n	(%)
Age		
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 %
Sex		
Female	151	67.1 %
Male	74	32.9 %
Length of Service		
Less than 6 months	18	8.0 %
6 months to 1 year	18	8.0 %
1 to 2 years	30	13.3 %
2 to 5 years	52	23.1 %
5 to 10 years	61	27.1 %
More than 10 years	46	20.4 %
Employment Status		
Contract of Service	40	17.8 %
Job Order	60	26.7 %
Permanent	125	55.6 %
Designation		
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 %
Educational Attainment		
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 %
Attendance to training or orientation on HCWM and associated risks		
Always: I consistently attend every relevant training or orientation session. (76-100%)	27	12.0 %
Frequently: I attend these sessions regularly, at least several times a year. (51-75%)	19	8.4 %
Occasionally: I attend these sessions from time to time, but not regularly. ((26-50%)	63	28.0%
Rarely: I attend such sessions infrequently or on a very irregular basis. (1-25%)	70	31.1 %
Never: 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.

Moreover, the result of a high perception on proper HCWM (52.2% - 58.4%) signifies safe practice which shows a higher finding versus a study is a little lesser or study in Bangladesh (54%), [62] Adama Hospital, Ethiopia, 34.9%, [28] Gondar Town, Ethiopia 31.5%, [47]. Nonetheless, this study has lower findings compared to India 59.1% [63], Nigeria 62%, and Pakistan 66.6% [40].

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

Statements	N = 226	
	n	(%)
1. Perceived practices on waste reduction/ minimization		
High	86	38.1 %
Moderate	115	50.9 %
Low	25	11.1 %
Very Low	0	0.00%
2. Perceived practices on waste identification		
High	132	58.4 %
Moderate	79	35.0 %
Low	15	6.6 %
Very Low	0	0.00%
3. Perceived practices on waste segregation		
High	131	58.0 %
Moderate	78	34.5 %
Low	16	7.1 %
Very Low	1	0.4 %
4. Perceived practices on waste disposal		
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 improper practices of these waste management revealed the highest level of perception was observed in waste identification and segregation with 64.2%. In this current study, 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 a higher result in terms of the risks associated with lack of proper HCWM compared to Gondar Ethiopia [47] and Bangladesh [62].

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

Statements	N = 226	
	n	(%)
1. Perceived risk associated with lack of proper practices on waste reduction/ minimization		
High	123	54.4 %
Moderate	87	38.5 %
Low	14	6.2 %
Very Low	2	0.9 %
2. Perceived risk associated with lack of proper practices on waste identification		
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 ($r = 0.286^{***}$). The results implied that the higher the perception on the practices of proper HCWM in terms of these categories by the healthcare workers, the higher the perception on the possible risks if there is a lack of proper practices on the management. In other words, should there be any improper 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.

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. This study has a higher level of safe practice compared to the same study from other developing countries like Ethiopia [28,34,47] and Bangladesh [62].

In the context of the study, because of well-defined policies and guidelines as well as strict implementation on the four identified basic steps in achieving proper waste management from among the public hospitals in the Philippines, it can be concluded that the probable risks the healthcare workers will be potentially exposed is nil. Even the reputation of the institution is also uplifted when obvious proper HCWM practices are observed. Adherence to the laws and legislations in terms of this aspect will be carried on especially its impact to the community in general and to the individuals in particular.

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.

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

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 nurses 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.

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

	Chi-square	20.2	5.14	42.6	9.28	19.5	10.2	26.8
Waste identification risk	df	12	3	15	6	24	18	15
	Sig	0.063	0.162	<.001	0.158	0.727	0.926	0.030
	Chi-square	7.84	4.99	40.8	12.3	21.7	12.5	19.9
Waste segregation risk	df	12	3	15	6	24	18	15
	Sig	0.797	0.173	<.001	0.055	0.597	0.819	0.176
	Chi-square	14.5	4.15	41.3	10.1	22.2	15.2	18.3
Waste disposal risk	df	12	3	15	6	24	18	15
	Sig	0.270	0.245	<.001	0.120	0.567	0.647	0.247

5. SUMMARY, CONCLUSION AND RECOMMENDATION

The study provided insight about the level of perception on proper healthcare waste management and its associated risk factors from among the healthcare workers in public hospitals of the Philippines. From the total participants, there were 41.8% aged 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. 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].

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.

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