



MANAGEMENT OF COVID-19 RELATED HEALTH CARE WASTE IN THE CITY OF TARLAC

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Abstract: *The conducted study evaluated the Management of COVID-19 Related Health Care Waste in the City of Tarlac in accordance with the issued Interim Guidelines stipulated on National Solid Waste Management Commission (NSWMC) Resolution No. 1364, series of 2020.*

The study evaluated the management of COVID-19 related health care waste in the City of Tarlac based on the specified guidelines in the following areas: (1) Waste Generation, (2) Segregation and Storage at Source, (3) Collection and Transport, (4) Treatment and Disposal, and (5) Occupational Health and Safety. The evaluation covered the year 2021 which involved 209 respondents from the Local Government Unit of Tarlac City, DENR-EMB, and Barangays within the City.

This study makes used three (3) instruments both direct and indirect methods for data gathering such as (1) questionnaire/data capture form, (2) interviews, and (3) documentary analysis.

The results of the study found that the Local Government Unit of Tarlac City Implemented the stated provisions on the management of COVID-19 related health care waste based on the NSMWC Resolution No. 1364 during the pandemic in 2021.

Moreover, it recommends measures to enhance the Management of COVID-19 Related Health Care Waste in the City of Tarlac.

I. INTRODUCTION

Protection against COVID-19 goes beyond using face masks and shields and adhering to the bare minimum health measures. It is also our responsibility to appropriately dispose of these potentially contaminated healthcare wastes (Department of Environment and Natural Resources Secretary, Roy A. Cimatu, 2022).

The pandemic has so far not materially altered our way of life in quite a while. In our country, the "new normal" began in earnest in March 2020. Facemasks and other personal protection equipment must be used when in public places, thus it is our duty to dispose of them in safely and properly.

Safe waste disposal services for medical waste are scarce globally, particularly in the least developed nations. Large increases in medical waste brought on by the COVID-19 epidemic have put pressure on already under-resourced healthcare facilities and exacerbated the environmental effects of solid waste.

An urgent need to improve waste management procedures is highlighted by a new World Health Organization (WHO) research that claims the COVID-19 pandemic response has resulted in tens of thousands of tons of additional medical waste being generated by health care waste management systems globally. Based on estimates, approximately 87,000 tons of personal protective equipment (PPE) were procured and shipped to support countries' urgent COVID-19 response needs through a joint UN emergency initiative between March 2020 and November 2021, according to the WHO's Global Analysis of Health Care Waste in the Context of COVID-19: Status, Impacts, and Recommendations. It's likely that much of this equipment was discarded.

To stop the spread of COVID-19 in numerous nations throughout the world, people are using these facemasks and other personal protective health equipment, including those who have not received a medical diagnosis of the disease (Keshini Madara Marasinghe, 2020). Most masks are made of durable plastic, and if they are thrown away, they can linger in the environment for a long time possibly hundreds of years. They can thereby affect people and the environment in several different ways (Roberts et al., 2020).

Despite being warned to use facemasks and other personal protective medical equipment, there hasn't been any guidance on how to properly dispose of them. Additionally, billions of facemasks are required each month around the world as countries start to ease lockdown regulations. A potential environmental catastrophe is on the horizon without better disposal methods (Roberts et al., 2020). The amount of medical waste in the environment increased as a result of COVID-19. There is a greater risk of COVID-19 spreading throughout communities in poorer and least developed countries due to poor and insufficient waste management procedures.

The threat will be greater in developing nations that do not have enough resources for solid waste management, even though some Asian countries still do not follow proper management strategies and a major issue that contributes to the contamination of solid waste containers in the public is the lack of solid waste containers. Most developing nations are widely believed to dump solid trash in poorly maintained and open landfills, including Cambodia, the Philippines, Thailand, India, Malaysia, Indonesia, Bangladesh, Vietnam, and Palestine. To lessen the threat of the COVID-19 pandemic spreading to the environment inside hospitals, neighborhood houses, and public spaces throughout Asia, standardization, protocols, norms, and stringent application of medical waste management should be thoroughly examined (Sangkham, 2020).

Moreover, on April 1, 2020, the Philippine Inter-Agency Task Force (IATF) for Emerging Infectious Disease issued Resolution No. 18, series of 2020, requiring all people living in Enhanced Community Quarantine (ECQ) areas to wear face masks, ear loop masks, reusable or DIY masks, face shields, handkerchiefs, or other protective equipment that can effectively reduce the transmission of COVID-19 whenever they are permitted to leave their homes. These are regarded as a component of the safety measures to stop the virus's transmission. However, this circumstance also contributed to a sharp rise in healthcare waste in the country.

More infectious wastes, including discarded PPE, are being produced by hospitals, health care facilities, barangay health centers, planned quarantine centers, and households during the surge of the pandemic in the Philippines in 2021. Non-segregation will result in an increase in hazardous waste. To stop the spread of the coronavirus, appropriate management and disposal of medical wastes and contaminated wastes are critical.

Medical waste disposal problems can have a significant negative influence on the environment. There is a great potential that these pollutants may wash away and end up in lakes, rivers, and oceans, harming our country's aquatic flora and fauna. Protecting the environment and the public's health and safety is the main justification for the practice of proper waste management.

The Department of Environment and Natural Resources (DENR) intends to provide funding to 227 local government units (LGUs) nationwide through the Environmental Management Bureau (EMB), which represents 81 provinces and 146 cities, for the appropriate collection, treatment, storage, and disposal of COVID-related healthcare wastes from homes, vaccination sites, testing, and quarantine facilities. However, medical waste produced by hospitals located inside their administrative boundaries will not be covered by the COVID-19 Healthcare waste program for LGUs.

The National Solid Waste Management Commission (NSWMC), an agency under the Office of the President issued NSWMC Resolution No. 1364, series of 2020 dated April 25th, a resolution Adopting Interim Guidelines on the Management of COVID-19 Related Health Care Waste chaired by the Department of Environment and Natural Resources (DENR) in coordination with proper government agencies to formulate appropriate issuances of COVID-19 Related Waste Management Plan; Step by step procedures of waste segregation and storage; Chemical Disinfection Procedures of Infectious Waste, Vehicles and Equipment Used in the Collection and Transport, Treatment and Disposal including Facilities; List of Best Available Intermediate Treatment Technologies with Description; and Occupational Health and Safety Plan for Waste Handling and Management of COVID-19 Related Waste.

Moreover, the Environmental Management Bureau, a DENR-affiliated bureau, is in charge of overseeing the monitoring and implementation of Republic Act 9003, also known as The Ecological Solid Waste Management Act of 2000, in Central Luzon. This law mandates the creation of an integrated solid waste management plan by local government units, including the City of Tarlac.

Currently, more than 100 cities and municipalities in Central Luzon have been using Metro Clark's sanitary landfill facilities at Kalangitan, Capas, Tarlac, as well as hundreds of industrial, commercial, and residential locators inside the two main economic zones in the area, particularly, Clark and Subic. To date, Central Luzon or Region 3 has the highest number of health care waste treatment, storage, and disposal facility in the country where all the collected COVID-19 related health care waste in the City of Tarlac is disposed of by the waste service provider straight after the treatment process.

The researcher is currently employed at the Department of Environment and Natural Resources – Provincial Environment and Natural Resources Office Tarlac and intended to evaluate the Management of COVID-19 related Health Care Waste in the City of Tarlac through the conduct of a study to prevent the possible spread or transmission of disease and to implement proper waste management to ensure the welfare and safety of the community and all personnel directly involved in the management of potentially infectious and contaminated wastes related to COVID-19. This will also serve as a wake-up call to the Local Government Unit to strictly implement laws, policies, and ordinances for their constituents to make the world a better place to live in.

II. STATEMENT OF THE PROBLEM

This study aims to evaluate the Management of COVID-19 Related Health Care Waste in the City of Tarlac in accordance with the National Solid Waste Management Commission (NSWMC) Resolution No. 1364, series of 2020.

Specifically, it sought to answer the following questions:

1. How is the Management of COVID-19 Related Health Care Waste be described and evaluated in terms of:
 - 1.1 Waste Generation
 - 1.2 Segregation and Storage at Source
 - 1.3 Collection and Transport
 - 1.4 Treatment and Disposal
 - 1.5 Occupational Health and Safety (OHS)
2. What are the problems faced by local government units in the management of COVID-19 related health care waste?
3. What measures can be proposed to enhance the management of COVID-19 related health care waste?
4. What are the implications of the study to public administration?

III. SIGNIFICANCE OF THE STUDY

The results of this study will determine the extent of the implementation of the management of COVID-19-related health care waste in the City of Tarlac. It will evaluate the waste generation; segregation and storage at source which is very crucial for the safety of the public health and the condition of the environment. Also, this study will assess the collection and transport system; treatment and disposal; and occupational health and safety practices of LGU based on the Interim Guidelines issued by the NSWMC. Problems faced, interventions and possible measures will also be determined in this study.

For the **National Solid Waste Management Commission & Environmental Management Bureau – Department of Environment and Natural Resources**, the result of this study will help them gauge the operation of Tarlac City LGU in the Management of COVID-19 Related Health Care Waste. It may also provide an insight into the formulation of policies and guidelines and guidance in the implementation of national policies.

For the **Barangay/Local Government Units – Tarlac City**, the result of this study will help them analyze and evaluate the proper management of health care waste at source up to treatment and disposal; and strengthen their resolve to formulate related ordinances for a safer and much easier implementation.

For the **Department of Interior and Local Government**, the result of this study will help the concerned official to assess and evaluate the health care waste management of Tarlac City LGU most especially on the institutional mechanism indicator stipulated on DILG MC No. 2020-147.

For the **Department of Labor and Employment**, the result of this study will determine the extent of compliance of Tarlac City LGU on the Occupational Safety and Health Standards for waste collectors during the COVID-19 pandemic in 2021.

To the **public**, the result of this study will waken their awareness of the importance of proper waste segregation especially those categorized as “infectious” which must not be mixed with other domestic solid wastes for the sake of our environment but more especially for our health.

The findings of this study may be used by **future researchers** as a point of reference and the springboard for other academic empirical work.

Finally, this study will enrich the existing reference materials for Public Administration **students** who are fascinated to pursue further studies of a similar nature.

IV. SCOPE AND DELIMITATION OF THE STUDY

This study focused mainly on the evaluation of the Management of COVID-19 related Health Care Waste in the City of Tarlac in CY 2021. It determined the waste generation; segregation and storage at source; collection and transport; treatment and disposal; and occupational health and safety of waste service collectors in the City. Problems and prosed measures of B/LGUs as to the management of COVID-19 related Health Care Waste were also identified. A total of 76 Barangays in the City of the Tarlac is the coverage in this study. However, private and government hospitals within the city are excluded from this research, it focuses more on establishments, and Barangay Health Centers/Rural Health Units COVID-19 related health care waste. LGU City Environment and Natural Resources Officer and staff, City Health Officer, CHO Environmental Sanitation Officer, Barangay Officials/Committee on Solid Waste Management, Barangay Health Workers, and Environmental Monitoring Officer from EMB at DENR-PENRO are the respondents of this study as well.

V. DEFINITION OF TERMS

For purposes of clarity, the following terms used in the study are defined:

Collection. In this study, collection refers to a stage of the waste management procedure. It means transporting solid waste from its point of origin to a landfill or treatment facility.

Coronavirus Disease. It's a disease-causing virus that affects animals and birds. Coronaviruses cause infections of the respiratory tract in humans that can vary from moderate to fatal (www.who.int).

Disposal. It refers to the collecting, processing, recycling, or disposal of human waste items.

Health Care Waste. Any solid waste produced in the production or testing of biologicals, as well as in the diagnosis, treatment, or immunization of people or animals or in related research (Department of Health, 2022).

Management. In this study, management means all activities and tasks for the purpose of achieving goals by ongoing activities such as planning, organizing, leading, and controlling are defined.

Occupational Health & Safety (OHS). It is a multidisciplinary practice that deals with the aspect of occupational health and safety, with a greater emphasis on avoiding workplace hazards.

Segregation. It refers to the sorting of various materials contained in solid waste in order to encourage resource recycling and re-use while also reducing the volume of garbage that needs to be collected and disposed of (Environmental Management Bureau, 2013).

Storage. In this study, storage refers to a container built of waste-compatible materials. This must be in good working order, with no leaks or residue on the container's outside.

Transport. It means an act or instance of transferring or conveying something from one place to another (merriam-webster.com).

Treatment. In this study, treatment means the operations required to guarantee that trash has the least possible impact on the environment.

Waste Generation. It refers to the waste produced domestically and commercially which is collected and processed by municipalities.

VI. CONCEPTUAL FRAMEWORK

The study was conducted to evaluate the Management of Covid-19 related Health Care Waste in the City of Tarlac. It assessed the waste generation; segregation and storage at source; collection and transport; treatment and disposal; and the occupational health and safety of waste service providers. Moreover, the study also determined the challenges being faced by the B/LGUs. Through these, recommendations were proposed to give solutions to the prevailing problem. Lastly, the implication of the study to public administration will be drawn.

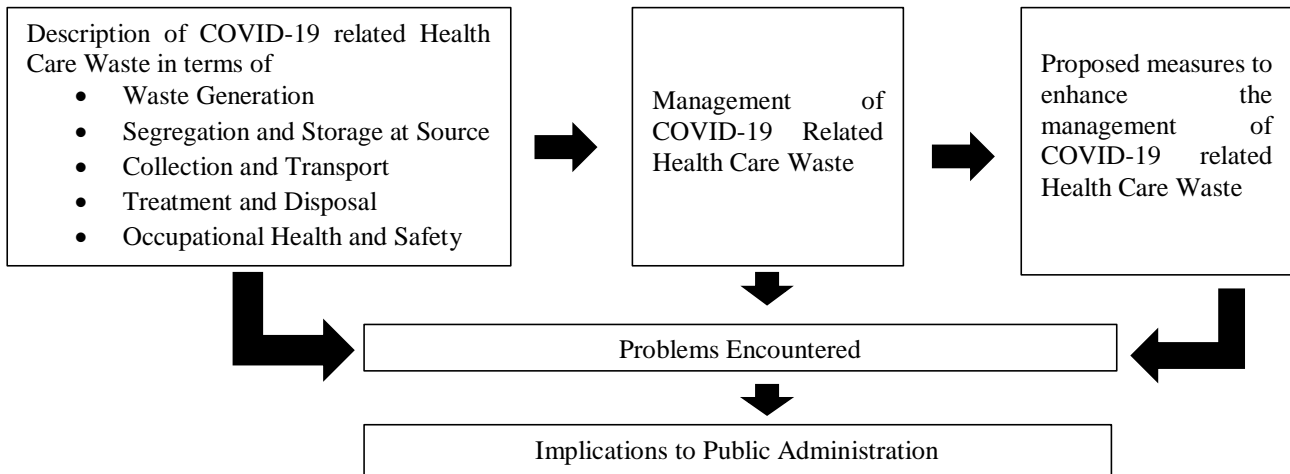


Figure 1. Paradigm of the Study

VII. RESEARCH DESIGN

The management of COVID-19-related health care waste in the City of Tarlac was assessed using the descriptive research design, which involved conducting surveys and interviews, document analysis, and the use of a questionnaire or data capture form. What exists about the current situation was the question that the descriptive study aimed to address (Costales et. al, 2005). Its primary goal, according to Heidenthalal (2003), is to accurately reflect the traits of individuals, circumstances, or groups as well as the frequency with which specific phenomena occur.

VIII. RESEARCH LOCALE

The study was conducted in the City of Tarlac, a 1st class component City and the capital of the Province of Tarlac best known for its fine foods and vast sugar and rice plantations covering seventy-six (76) barangays namely: Aguso, Alvindia, Amucayo, Armenia, Asturias, Atioc, Balanti, Balete, Balibago I, Balibago II, Balinganaway, Banaba, Bantog, Baras-baras, Batang-batang, Binaugangan, Bora, Buenavista, Buhilit, Burot, Calingcuan, Capehan, Carangian, Care, Central, Culipat, Cut-cut I, Cut-cut II, Dalayap, Dela Paz, Dolores, Laoang, Ligtasan, Lourdes, Mabini, Maligaya, Maliwalo, Mapalacsiao, Mapalad, Matatalaib, Paraiso, Poblacion, Salapungan, San Carlos, San Francisco, San Isidro, San Jose, San Juan de Urquico, San Juan Bautista, San Juan de Mata, San Luis, San Manuel, San Miguel, San Nicolas, San Pablo, San Pascual, San Rafael, San Roque, San Sebastian, San Vicente, Santa Cruz, Santa Maria, Santo Cristo, Santo Domingo, Santo Nino, Sapang Maragul, Sapang Tagalog, Sepung Calzada, Sinait, Suizo, Tariji, Tibag, Tibagan, Trinidad, Ungot and Villa Bacolor

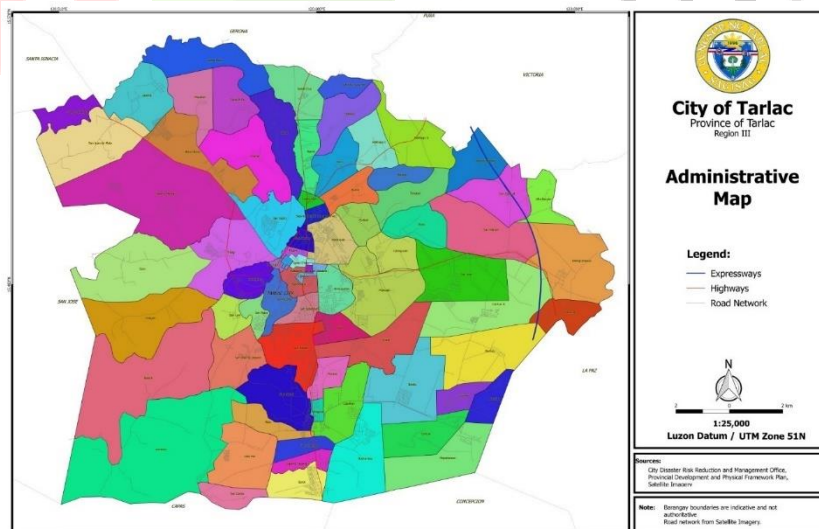


Figure 2. Tarlac City Map
(Source: Tarlac City Planning and Development Office)

IX. RESPONDENTS OF THE STUDY

The respondents of the study are two hundred nine (209) Barangay Officials/Barangay Committee on Solid Waste Management, Barangay Health Center Personnel, Environmental Monitoring Officer (EnMO) from EMB, City Health Officer, CHO Environmental Sanitation Officer, City ENR Officer and staff of Local Government of Tarlac City.

Table 1
Distribution of Population of the Respondents

	No.
Barangay Officials/Committee on Solid Waste Management	103
Barangay Health Center Personnel	96
City Environment and Natural Resources Officer & Staff	7
City Health Officer	1
CHO Environmental Sanitation Officer	1
Environmental Monitoring Officer (EnMO) – DENR-EMB	1
TOTAL	209

X. SAMPLING DESIGN

A purposive sampling design is used in this study. It is an intentional selection of informants based on their ability to elucidate a specific theme, concept, or phenomenon (Robinson, 2014). According to Schutt (2006), the selection process involves identifying themes, concepts, and indicators through observation and reflection.

XI. METHODS OF GATHERING DATA

In terms of instrumentation, the researcher used three (3) instruments namely: (1) questionnaire/data capture form; (2) interview guide; and (3) documentary analysis.

Questionnaire/Data Capture Form. The questionnaire used by the researcher served as a tool to evaluate the Management of COVID-19 related Health Care Waste in the City of Tarlac in 2021. It was based on the National Solid Waste Management Commission Resolution No. 1364, series of 2020. The questionnaire is composed of two (2) parts: the first part determined the evaluation of the Management of COVID-19 related Health Care Waste sts of five (5) indicators: (1) Waste Generation, (2) Segregation and Storage at Source, (3) Collection and Transport, (4) Treatment and Disposal, and (5) Occupational Health and Safety. The second part was about the problems being faced by the B/LGUs in the management of COVID-19 health care waste in 2021, wherein it is answerable by putting a check (✓) inside the provided box on the questionnaire. As to the proposed measures, the researcher conducted an analysis based on the identified problems of the respondents.

Interview. This instrument was used to ask follow-up questions to the respondents as they answer regarding the management of COVID-19 related health care waste in the City of Tarlac in 2021. Since the interview was conducted face-to-face, the researcher was able to clarify questions regarding the data gathered from the respondents at once. This also helped the researcher to gather supplementary information and details on the management of COVID-19 related health care waste from the respondents.

Documentary Analysis. This procedure was used by the researcher to analyze documentary evidence and answer specific questions based on the guideline stated in the NSWMC Reso No. 1364. The waste service provider billing invoice and MOA with the LGU were reviewed for the interpretation of data and to determine the volume of waste generated from COVID-19 in 2021 to gain meaning and empirical knowledge of the construct being studied by the respondents.

XII. EHTICAL CONSIDERATION

Full consent of the respondents was obtained before the conduct of the study. A letter request was also sent to the respective offices of the respondents for the conduct of data gathering and interviews. Discussion on the purpose of the study to be conducted was also done with their head of office. Respect for the dignity of the respondents was prioritized and rest assured that the data gathered are confidential and will only be used for academic purposes. Further, any type of misleading information, as well as representation of primary data findings in a biased way was avoided.

XIII. STATISTICAL TREATMENT

To facilitate interpretations and analysis, data collected were tallied and presented on tables and simple percentages.

Frequency. The frequency (or absolute frequency) of an event in statistics refers to how frequently the occurrence took place in an experiment or study.

Percentage. It is one of the most frequent ways to represent statistics. The most basic application of percentage is to compare one quantity against another, with the second quantity rebased to 100.

Ranking. This refers to establishing the order of importance or capability for groups of individuals or objects. This was used in the study to indicate how an item relates to the group. The numerical values of the data were organized from highest to lowest.

Mean. This was determined by adding all the data points in a population and then dividing it by the number of points.

In order to analyze the data gathered from the respondents in relation to the Management of COVID-19 Related Healthcare Waste in the City of Tarlac in 2021, frequency, percentage, and ranking were used.

The mean represents the average or middle value of all the data in a dataset as a single number. It was used to interpret the means and overall means of the evaluation of the Management of COVID-19 related healthcare waste in the City of Tarlac.

The following formula was used in describing the response options of the respondents and a corresponding value was assigned to get the weighted mean of each item.

The formula used is as follows:

$$\text{Weighted Mean} = \frac{f(5) + f(4) + f(3) + f(2) + (1)}{N}$$

Where 5, 4, 3, 2, 1 = corresponding value
 f = frequency of every response options
 N = Total number of respondents who answered

Likert Scale. In survey research, it is the method for scaling responses that is most frequently used. The respondent could evaluate how much they agreed or disagreed with a statement using a five-point scale in the study. The following index of restrictions and verbal descriptions will be used to interpret the findings (Martin, 2012):

The Likert Scale was used to evaluate the management of COVID-19 related Health Care Waste as to waste generation; segregation and storage at source; collection and transport; treatment and disposal; and occupational health and safety of waste service providers in the Province of Tarlac as described below:

Index	Range	Adjectival Rating
5	4.21-5.00	Highly Implemented
4	3.41-4.20	Implemented
3	2.61-3.40	Moderately Implemented
2	1.81-2.60	Fairly Implemented
1	1.00-1.80	Poorly Implemented

XIV. PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

The tables presented in this chapter showed the Management of COVID-19 Related Healthcare Waste in the City of Tarlac as to the evaluation of Barangays and LGU Officials during the pandemic in CY 2021.

1. Management of COVID-19 Related Healthcare Waste in the City of Tarlac

The impacts of COVID-19 are changing how we live from day to day. The management of hazardous waste is crucial to reducing long-term threats to human and environmental health, even if national and municipal initiatives are primarily focused on preserving lives and local economies. To safeguard communities and medical personnel from the deadly coronavirus disease and to protect the environment from the pollution that could have a significant negative impact on the Province's efforts to sustainably conserve its biodiversity, COVID-19 healthcare waste management is of utmost importance.

1.1 Waste Generation

The introduction of COVID-19 has led to an increase in domestic hazardous and plastic waste volume as well as medical waste all over the world, creating an urgent need for proper waste management. Waste Generation includes all items that are discarded, regardless of whether they are recycled or dumped in a landfill. Based on documentary analysis and interviews with the respondents of the study, the generation of COVID-19 related healthcare waste indicated in National Solid Waste Management Commission Resolution No. 1364, series of 2020 is evaluated and identified.

Table 2

Waste Generation of COVID-19 Healthcare Waste

	Mean	Adjectival Rating
COVID-19 related infectious and contaminated wastes such as but not limited to face masks, cottons, tissue papers, testing kits, etc. generated from the households, offices, schools, public wet markets, commercial and industrial sources, and other facilities deemed as safe temporary shelters for frontliners were properly collected.	4.21	Highly Implemented
Masks, gloves, and any other disposable PPEs used by waste workers during the collection and handling of waste, cleaning, and disinfection activities of the vehicle and facilities were also collected and classified according to type.	3.89	Implemented
GRAND MEAN	4.10	Implemented

Table 2 showed that the collection with regards to the composition of waste generation of COVID-19 Healthcare Waste in the City of Tarlac is Implemented in accordance with the Interim Guidelines of NSWMC Resolution 1364, series of 2020. The grand mean of 4.10 with an Adjectival Rating of Implemented was obtained from the survey taken from B/LGUs Officials, Barangay Health workers, City ENR Officer and staff, City Health Officer, CHO Environmental Sanitation Officer, and DENR-EMB personnel who are the respondents of this study.

It can also be seen from the table that related infectious and contaminated healthcare waste associated with COVID -19 generated from the different establishments, Barangay Health Centers, and RHUs in the City were collected gained a weighted mean of 4.21 with an adjectival rating of Highly Implemented. Based on the data gathered from the respondents, a total of 2,213 kilograms of sharp infectious wastes was collected and transported by the waste service provider of the City during the period January to October 2021. During the 1st semester of CY 2021, the City accumulated a total of 1,229 kilograms of sharp infectious waste and for the period of July to October, a total of 984 kilograms was generated. The respondents stated that most of the collected sharp possibly contaminated healthcare wastes were composed of syringes, needles, and vials from coronavirus disease vaccine, flu vaccine, pneumococcal vaccine, and booster shots. They also disclose that only two (2) collections and transport were made with the waste service provider in 2021 since the containers from the LGU facility were not yet full and due to additional various requirements set by the DENR-EMB on the collection and transport of infectious waste.

Other COVID-19 related healthcare waste such as used cotton, PPEs, facemasks, face shields, non-sterile gloves, and footwear was also collected and handed to the City ENRO personnel for disinfection prior to disposal. They also added that these COVID-19 related healthcare wastes generated in 2021 were mostly accumulated from the Barangay Health Centers/RHUs, testing centers, quarantine facilities, and different offices and establishments in the City. This also includes any other disposable PPEs used by waste workers during the collection and handling of waste, cleaning, and disinfection activities which obtained a weighted mean of 3.89 or an adjectival rating of Implemented. Respondents also stated that waste collectors frequently wore coverall PPEs such as boots, gloves, facemask, and other protective equipment during the scheduled collection of waste and disinfection in their respective Barangays and within the establishments in the City proper during the pandemic in 2021 to avoid possible contact with potentially COVID-19 associated waste and individuals. This is also in accordance with the Sangguniang Panlungsod Resolution No. VIII-15-212 requesting the City Mayor to require the contractor for garbage collection and disposal to provide adequate PPEs for the safety and protection of their garbage collection personnel against the coronavirus disease 2021.

In summary, Table 2 showed that a total of 2,213 kilograms of sharp infectious wastes were generated from January to October 2021 in the City of Tarlac. Moreover, different types of COVID-19 related healthcare waste generated from various offices in the City were also identified based on the information and data gathered from the respondents during the conduct of the interview.

1.2 Segregation and Storage at Source

Healthcare waste needs to be appropriately managed and separated at the source in order to prevent harm to human health and the environment as well as to maintain material recovery and resource efficiency. To increase the effectiveness of segregation and reduce improper container use, proper container placement and labeling must be carefully considered. Sorting makes it simpler to identify things that can be reused, identify recyclable materials, and reduce overall trash production. Beyond that, though, there is a moral requirement to manage trade waste responsibly. Trade waste won't be effectively segregated, therefore it will end up mixed together in landfills. In order to reduce any potential risks of COVID-19 infection throughout the waste management process, certain preventative steps, adaptations, and preparations should be made in addition to adhering to the operational norms currently in place for the handling of hospital waste.

Table 3
Segregation and Storage at Source

	Mean	Adjectival Rating
Waste generators implemented proper waste segregation at source and ensure that COVID-19 related infectious wastes are not mixed with other domestic solid wastes.	3.37	Implemented
Infectious wastes were stored in yellow plastic bags/container bins or any storage bags and properly labeled.	3.21	Moderately Implemented
Waste containers were properly covered and contained to prevent access to animals or children.	3.44	Implemented
The labeled storage bags/container bins were closed and not too full to prevent hand contact during handling/delivery for collection.	3.34	Moderately Implemented
Waste generators properly disinfected COVID-19 related infectious and contaminated health care waste.	3.76	Implemented
Waste generators followed instructions on the safe handling of infectious and contaminated waste for collection as well as proper hygiene practices.	3.83	Implemented
GRAND MEAN	3.49	Implemented

Exhibited in Table 3 that the segregation and storage at source of COVID-19 related healthcare waste in the City of Tarlac are Implemented consistent with the provisions stipulated in the specific guidelines on segregation and storage of COVID-19 related healthcare waste issued by the NSWMC. The grand mean of 3.49 with an adjectival rating of Implemented derived from the respondent's answers wherein they added that somehow they followed the specifications on segregation of healthcare waste

associated with COVID-19 in 2021 specifically in the period of March and September where it is the surge of coronavirus disease infection in the City according to the Local Government Unit.

As represented in table 3, waste generators followed the proper hygiene practices as well as the instructions by the authority on the safe handling of contaminated wastes gained a mean of 3.83 with a corresponding adjectival rating of Implemented. It was a practice among the respondents to regularly disinfect themselves with soap and water and alcohol upon discarding healthcare wastes associated with COVID-19 for protection and assurance that they are sanitized to avoid possible infection to the virus and to lessen the anxiety that they might experience symptoms related with COVID. The respondents also stated that they did not fail to remind their constituents and the community as to the proper handling of COVID-19 healthcare wastes.

Table 3 also showed that waste generators properly disinfected their COVID-19 related infectious and contaminated healthcare wastes which obtained a mean of 3.76 with an adjectival rating of Implemented. Different households have their own ways of how disinfecting their COVID-19 related healthcare wastes according to the respondents to make sure that safety precautionary measures are followed. Further, COVID-19 healthcare wastes extracted from households with confirmed positive cases were automatically disinfected by the disinfection team of CENRO from the LGU in coordination with the Barangay Officials concerned to ensure the safety of the neighborhood and the community and particularly to avoid reinfection of the disease within the vicinity.

It can also be seen from the table that waste containers were properly covered to prevent access from children and animals attained a mean of 3.44 with an adjectival rating of Implemented. Respondents asserted that sealed waste containers must only be brought to the pick-up points during the scheduled time of collection to prevent from stray animals or else these containers will be sent back to their respective houses for them to keep until the next scheduled collection.

On the other hand, proper waste segregation at source to ensure that COVID-19 related healthcare waste is not mixed with other domestic solid wastes obtained a weighted mean of 3.37 with an adjectival rating of Moderately Implemented. At Barangay Health Centers and Offices, the respondents disclose that the proper segregation of waste is implemented since the conduct of COVID vaccination, booster shot, flu, and a pneumococcal vaccine is sustained in 2021. They added that these wastes have their own containers from the City Health Office to classify the type of waste being discarded and to avoid mixing with other waste not related to COVID.

It can also be gleaned in the table that container bins with labels were closed and not too full during handling/delivery for collection in 2021 gained a weighted mean of 3.34 with an equivalent adjectival rating of Moderately Implemented. Although these bins were closed and not too full, the respondents added that some has no labels attached to the containers to specify whether the waste to be collected by waste collectors is healthcare waste or domestic waste.

Moreover, infectious wastes stored in yellow plastic bags/container bins with labels attained a weighted mean of 3.21 with a corresponding adjectival rating of Moderately Implemented. During the surge of COVID-19 infection in the City in 2021, the respondents stated that there are specific bins solely for COVID-19 related healthcare waste in various B/LGUs offices and establishments within the city proper, hence, it is not compliant with NSWMC Resolution No. 1429, series of 2021 wherein it is stated on the provisions that yellow bins must be provided not only by National Government Agencies but also with the LGUs.

To encapsulate the specific guidelines stipulated on NSWMC Resolution No. 1364, series of 2020 reflected in Table 3, the result of the data gathering among the respondents found out that in the City of Tarlac, specified guidelines were implemented, yet, some only were moderately followed due to lack of information among the Barangay Officials which was also based on the ocular observation of the researcher during the conduct of the interview.

1.3 Collection and Transport

The fact that the source of COVID-19 medical waste has been complex, the initial management of medical waste from the source control is critical. In order to collect different types of waste, waste collection and transport often involves making daily trips to a number of residential and commercial locations. This can be done manually or by employing a garbage-disposal vehicle to lift and empty waste containers. Garbage pickup and transport is a crucial function that must be kept as routine as possible during the epidemic to avoid waste building up in the neighborhood. Waste collection personnel may have increased viral exposure as the epidemic spreads since they often contact possibly contaminated surfaces and have heavier workloads.

The certain guidelines in NSWMC Resolution No. 1364 provide practical measures for B/LGUs and workers in the waste collection sector in working safely, while also trying to aid in the maintenance of continuous improvement and community sanitation during the pandemic.

Table 4
Collection and Transport

	Mean	Adjectival Rating
Proper chemical disinfection of infectious and contaminated health care wastes was done by waste collection personnel during waste collection and transport, to reduce/minimize biological hazards and exposure of waste collectors and transporters.	3.61	Implemented
Infectious and contaminated health care wastes were collected and transported on a separate schedule or contained in a separate container within the collection vehicles for storage of infectious waste to ensure that infectious waste is not mixed with other waste.	3.36	Moderately Implemented
Conducted orientation to waste collection personnel on the proper handling of infectious and contaminated health care wastes, the hazards associated with it, and the wearing of appropriate PPEs.	4.11	Implemented
Manual sorting of wastes in collection vehicles and disposal facilities is not allowed.	2.63	Moderately Implemented
Regular disinfection/sanitizing activities for collection and disposal of vehicles and equipment, including facilities is conducted.	4.27	Highly Implemented
GRAND MEAN	3.60	Implemented

It is shown in the above table that the interim guidelines on NSWM Resolution 1.3 are Implemented in the City of Tarlac, which attained a grand mean of 3.60. In the Resolution issued by the NSWMC, it was clearly specified in provision 1.3 Collection and Transport of COVID-19 related healthcare wastes the guidelines to be followed by the LGUs to ensure the safety and welfare of all personnel directly involved in the management of potentially infectious and contaminated healthcare waste related to COVID-19.

As represented in table 4, the conduct of regular disinfection activities for waste collection and disposal vehicles and equipment including their facilities is Highly Implemented in the City of Tarlac in 2021, which gained a weighted mean of 4.27. Relative to the accumulated information from the respondents, collection vehicles were disinfected before entering the motorpool where a full-sanitation process will be administered including washing of the loader with water mixed with disinfectants, misting of the whole collection vehicle including the wheels, and fogging of the chassis and the driver seat. Right after the departure, the whole facility was disinfected to avoid possible contamination within the area. These operations of the LGU are still in progress, especially for those vehicles used in the collection of healthcare wastes from households with confirmed COVID-19 positive cases.

Further, according to the data gathered by the researcher, the conduct of orientation as to the proper handling of infectious and contaminated healthcare wastes associated with COVID-19, the hazards that they might get from it, and the proper wearing of PPEs gained a weighted mean of 4.11 with an adjectival rating of Implemented. Based on the statements of the respondents during the interview, synchronous orientations to waste service collectors and Barangay Officials together with BHWs were conducted in 2021 for the appropriate management of COVID-19 related healthcare waste spearheaded by the City Health Office, DENR-EMB, and the Provincial Government of Tarlac. The respondents also added that there is an existing protocol to waste collectors from the City LGU that they are not allowed to go on a collection without proper training and orientation on the stipulated regulations of the concerned government agencies which aim to avoid possible health risks among waste collectors and waste generators.

Proper chemical disinfection of infectious and contaminated healthcare wastes related to COVID-19 was Implemented in 2021 in the City of Tarlac based on the accumulated data from the respondents with a weighted mean of 3.61. Aside from wastes associated with COVID-19 confirmed positive cases collected from the household source, the respondents enunciated that domestic and residual wastes acquired during the collection were also disinfected after loading at the collection vehicle or right after roaming on the scheduled barangay. The respondents also added that some waste generators within their communities also disinfect their COVID-19 related healthcare waste prior to disposition for some health reasons and for precautions. Through the execution run-through, biological hazards and exposure will be reduced or minimized among the waste collectors and transporters during the collection and transport of wastes for dispatch.

Moreover, in 2021, the collection and transportation of COVID-19 healthcare wastes collected in quarantine facilities has a fixed collection schedule of 3-times a week (Monday-Wednesday-Friday) to circumvent that the bulk of accumulated wastes from COVID-19 facilities will be collected and transported to a designated facility prior to turnover to waste service provider for treatment, storage, and disposal (TSD) before the disposition to the provided sanitary landfill. Whereas, the collection of COVID-19 wastes generated from households with positive cases within the City proper was on daily basis due to the lack of availability of quarantine facilities as a result of the rapid increase of COVID-19 positive cases in the City in 2021. As closed separate collection vehicles were used on the said undertakings to guarantee the safety of the waste collectors and to avoid mixing with other domestic wastes acquired from the households, respondents also stated that some of the waste specifically derived from households were mixed with minimal domestic and residual wastes. Hence, these specific guidelines from NSWMC Resolution No. 1364 on collection and transport obtained a weighted mean of 3.36 with an adjectival rating of Moderately Implemented.

Apart from this, prohibiting manual sorting of wastes in collection vehicles and disposal facilities attained a weighted mean of 2.63 with an adjectival rating of Moderately Implemented. Respondents disclosed that waste collectors from a smaller

types of trucks for collection conducted manual sorting in collection vehicles since some of the collected wastes from households have no labels as to the classification of wastes in accordance with NSWMC Resolution. They also stated that upon the arrival of wastes at the designated facility, coverall PPEs such as facemask, non-sterile gloves, and boot covers worn by waste collectors were also disposed to the provided storage facility by the General Services Office for pick-up of waste service provider of the City for treatment and disposal to the sanitary landfill.

Briefly, table 4 showed that Resolution No. 1364 of NSWMC with particular specifications on Collection and Transport of COVID-19 healthcare wastes in the City of Tarlac is Implemented, yet, some guidelines stated were Moderately Implemented due to lack of discipline and strict implementation among the community as to the proper segregation of healthcare wastes prior to collection and transport. Along with these, safety precautionary measures and considerations were still managed for the sake of the health risks and technicalities that may affect the waste collectors and generators including the operation of the waste service provider.

1.4 Treatment and Disposal

Unsafe waste management could have unanticipated consequences for human health and the environment. The safe treatment and disposal of this waste would seem to be a vital component of effective emergency preparedness. In our current situation, improper waste treatment and disposal may hasten the spread of COVID-19, posing a serious risk to medical and sanitation workers, patients, and society as a whole. As a result, there is an urgent need to consider emerging challenges in the handling, treatment, and disposal of COVID-19 healthcare wastes during and after the outbreak. On-site treatment of healthcare waste gives healthcare facilities more control over the waste disposal process as well as waste disposal costs. Treatment technologies may be a more cost-effective option, and many manufacturers have already simplified their systems to make processing relatively simple. Moreover, finding the best healthcare waste disposal method is a difficult decision because it is influenced by numerous factors, including the socioeconomic and ecologic sustainability dimensions.

The NSWMC Resolution No. 1364, through its guidelines, specified regulations related to the management of COVID-19 related healthcare wastes specifically on Collection and Transport covering five (5) stipulated directives on 1.4 under the Specific Guidelines of the said resolution. Through these, the researcher evaluated the management of COVID-19 related healthcare waste in the City of Tarlac based on the accumulated data from the respondents as well as the conduct of the interview.

Table 5
Treatment and Disposal

	Mean	Adjectival Rating
All infectious and contaminated health care wastes were properly treated with the best available technologies (i.e. sterilization, thermal processing like pyrolysis and gasification, incineration, etc.) approved by the DENR, DOH, and other concerned regulatory agencies.	3.88	Implemented
Waste treaters ensured that the treatment efficacy of the technology is in accordance/compliant with the waste treatment guidelines stipulated in Health Care Waste Management Manual or JAO DOH-DENR on HCWM. Microbial laboratory test results is submitted to DOH and DENR for validation as prescribed.	3.68	Implemented
Waste disposal facility operators developed a dedicated or separate cell for treating infectious waste or residue.	3.48	Implemented
All treated infectious and contaminated health care waste and/or residues are disposed of in a separate cell within the approved sanitary landfill.	3.51	Implemented
Waste disposal personnel were informed about the classification of the waste being delivered (i.e. treated infectious and contaminated health care waste) to take precautionary measures i.e. wearing of PPEs (including but limited to coveralls, face masks and/or goggles, gloves and closed shoes/industrial boots), maintaining safe distance and avoid direct contact with the waste.	3.63	Implemented
GRAND MEAN	3.64	Implemented

Table 5 showed that COVID-19 related healthcare wastes were properly treated with the best technologies approved by the DENR, DOH, and other concerned regulatory agency. This ensures that the treatment efficacy of the technology is in accordance or compliant with the waste treatment guidelines stipulated in the HCWM Manual or JAO DOH-DENR on HCWM. In the City of Tarlac, results showed that it obtained a weighted mean of 3.88 and 3.68 respectively with a corresponding adjectival rating of Implemented. Treatment of possible infectious or contaminated healthcare waste was needed to be administered in order to sanitize such waste prior to its disposal. By definition, the thermal process is a method of sanitizing waste by applying heat to it. The basic function of thermal treatment is to integrate waste into a sustainable and functional end product, thereby reducing the amount

that must be disposed of in landfills. According to the respondents, autoclave sterilization, a thermal process, is used by the waste service provider in treating COVID-19 related healthcare wastes acquired from the storage facility of LGU. Through this process, heat is used in autoclave sterilization to kill microorganisms such as bacteria and spores attached to healthcare wastes. Pressurized steam provides the heat. The pressurization of the steam allows it to reach the high temperatures required for sterilization which are 121 °C (250°F) and 132 °C (270°F). Autoclave sterilization is one of the most common and effective technologies and processes used in health care waste treatment, according to the Department of Health's Health Care Waste Management Manual, under Chapter 6 Waste Treatment and Disposal System. Furthermore, this process of treatment is approved under Specific Criteria, Standards, and Guidelines stipulated in Joint DENR-DOH Administrative Order No. 02, series of 2005.

It can also be seen from the table that waste disposal personnel were informed about the classification of waste being delivered for precautionary measures gained a weighted mean of 3.63 with an adjectival rating of Implemented in 2021 in the City of Tarlac. The City Health Office which provided information services on health and sanitation measures and also ensured that these are being enforced spearheaded the conduct of simultaneous orientations and seminars to LGU's waste collectors and BHWs on the Barangay level on the proper classification of waste generated and collected during the pandemic in 2021. The respondents also added that on Barangay Health Centers/RHUs, there is a specified container solely for COVID-19 related healthcare wastes acquired during the conduct of vaccination on their respective barangays. Vials of COVID vaccine, syringes, non-sterile gloves, pieces of cotton, footwear, facemasks, and faceshield have their own separate closed containers according to their type to avoid mixing with papers and other residual waste during the conduct of vaccination. In addition, the respondents affirmed that CHO staff and BHWs wore a complete set of PPEs during the conduct of vaccination in 2021 to guarantee that contamination and possible infection will be avoided between the health workers and the community. Healthcare wastes generated from barangay vaccination drives are collected by waste collectors of the City wearing coverall PPEs while maintaining a safe distance to steer clear of probable risks to occur during the collection and transport, as per respondents.

Further, a waste disposal facility with a separate cell for all treated and contaminated healthcare wastes or residues to ensure that these wastes will be disposed of within the approved sanitary landfill attained a weighted mean of 3.51 and 3.48 with an adjectival rating of Implemented. As per data gathered from the respondents, upon collection of sharp healthcare wastes generated from COVID-19 at the storage facility of LGU, waste service provider transport these wastes in a closed container truck to their facility in Capas, Tarlac for treatment prior to disposal to the provided sanitary landfill. The Safewaste Incorporated, the partner waste service provider of Tarlac City LGU located at Brgy. Cut-Cut I, Capas, Tarlac are responsible for the treatment of collected sharp healthcare wastes within the City excluding the private and public hospitals which have their own waste service provider and disposed of their treated healthcare wastes in a separate container within the approved sanitary landfill at Metro Clark Landfill which is operated by Metro Clark Waste Management Corporation in order to prevent from mixing with other domestic wastes dumped at the sanitary landfill. The MCWM facility is located on 100 acres within the Clark Special Economic Zone (CSEZ) and has provided local governments and industrial clients from Central Luzon to Metro Manila. MCWM is the Philippines' only sanitary landfill operator that is ISO Certified for Management, Environmental Compliance, and Operational Health And Safety.

Therefore, the prescribed guidelines incorporated on NSWMC Resolution No. 1364 item 1.4 Treatment and Disposal of COVID-19 related healthcare waste is Implemented in the City of Tarlac in 2021 with a grand mean of 3.64 which complies with waste treatment guidelines stipulated in the HCWM Manual of DOH and Joint DAO with DENR. It also concludes that waste collectors are aware of the classification of wastes being collected and the precautionary measures needed to be undertaken to avoid possible direct contact with COVID-19-associated wastes.

1.5 Occupational Health and Safety

Protecting workers against accidents, harm, and exposure to dangerous substances is the main objective of occupational health and safety (OHS). Even though accidents might happen at any time, it is the employer's responsibility to take precautions to ensure a safe and healthy workplace. There is no denying that there are safety risks in every industry. Classifying these threats and ensuring that employees have the appropriate training, safety equipment, and other resources is the most crucial component of an effective occupational health and safety strategy. Failure to put into place efficient rules and safety measures can lead to accidents, decreased productivity, especially in the absence or loss of trained employees, and workers' compensation claims. The threat varies depending on the type of services performed, the possibility for persistent or unprolonged social contact, and the contamination of the working place.

These specific provisions of NSWMC Resolution No. 1364 evaluated the Management of COVID-19 related Healthcare Wastes including the Occupational Health and Safety of waste service personnel in the City of Tarlac in 2021 through the data accumulated and consolidated from the identified respondents of the study. Through analysis, measures were proposed to elude possible health risks that may occur during the conduct of waste collection activities and to gain additional information on waste management system that will help to broaden the knowledge of waste collection personnel and waste generators.

Table 6
Occupational Health and Safety (OHS)

	Mean	Adjectival Rating
Implemented strict occupational health and safety plan for the guidance of personnel.	3.73	Implemented
All waste service personnel strictly adhered to enhanced hygiene norms, including frequent change and cleaning and disinfection of PPEs (including but not limited to coveralls, face masks and / or goggles, gloves, and closed shoes / industrial boots).	4.32	Implemented
Disinfectants and hand sanitizers in every collection vehicle was available.	4.28	Highly Implemented
Conducted orientation and trainings to workers on the proper usage and maintenance of PPEs; training on Occupational Health and Safety including description of the hazards in the workplace, environmental and administrative controls, properties of the PPEs, etc.	3.92	Implemented
Observed basic hygiene practices such as washing of hands with soap and water; avoiding touching of face, mouth, eyes, nose, or open sores and cuts while handling infectious waste or special waste to reduce risks and protect against illness due to infectious waste.	4.49	Highly Implemented
GRAND MEAN	4.15	Implemented

Represented in Table 6, Occupational Health and Safety among waste service collectors in the City of Tarlac is Implemented with regards to the interim guidelines of NSWMC Resolution 1364 item 1.6 which gained a grand mean of 4.15. This is also to infer that no incident of COVID-19 positive case and other severe health cases were reported among the waste collectors during the surge of the pandemic in 2021 acquired from work.

Based on the data gathered by the researcher from the respondents, observance of basic hygiene practices and adherence to enhanced hygiene norms including frequent change and cleaning of PPEs is Highly Implemented to reduce risks and to protect waste service personnel against illness due to infectious waste associated with COVID-19 gained a weighted mean of 4.49 and 4.32, respectively. Among the City LGU's waste collectors, systematic sanitation and disinfection of coverall PPEs used were implemented in 2021. The respondents stated that upon the arrival of waste collection vehicles at the motorpool, waste collectors wearing coverall PPEs disinfected the vehicles with a full sanitation process. Right after, waste collectors disinfected each other with the use of available equipment at the facility such as misting or fogging machine with water and disinfectants mixed with it prior to the disposal in case disposable PPEs were used, while soaking with warm water with detergent was used for reusable ones. Respondents also added that taking a bath right after the disinfection of PPEs was regularly conducted to prevent any health risks that may occur. Wearing coverall PPEs also helped waste collectors to ensure that possible infection and contamination with COVID-19 were avoided the same with getting cuts and sores since broken glass or sharp objects and branches of fallen trees are not included with the wastes being collected by the waste collectors.

It can also be gleaned from the table that the availability of disinfectants and sanitizers in every collection vehicle used in the City of Tarlac is Highly Implemented obtaining a weighted mean of 4.28. The respondents stated that after loading such wastes to the collection vehicle at every pick-up point, disinfection follows to ensure that potentially COVID-19 contaminated wastes were sanitized. Hand sanitizers or alcohol were also available on the driver's seat to make sure that waste collectors and drivers were sanitized in case of contact. According to the data gathered, procurement of these COVID-19 essentials was made possible with the use of the City emergency fund in 2020 and with the in-kind donations from politicians and Tarlaquenos to the LGU for a more efficient and effective COVID response for disinfection within the City.

Based on the gathered data from the respondents, orientations and training were conducted to waste service personnel on the proper usage and maintenance of PPEs; OHS description of hazards in the workplace and environmental and administrative controls in 2021 which attained a weighted mean of 3.92 with an adjectival description of Implemented. The respondents stated that through the City Health Office and the Environmental Management Bureau, training, orientations, and IECs were conducted face-to-face and with the use of online platforms. They also added that these activities are very important during the surge of COVID-19 in 2021 in the City for them to have enough knowledge of the specific guidelines being implemented by the LGU and NGAs. It is also stated on Requirements for Proper Hazardous Waste Management of The Procedural Manual Title III of DAO 92-29 "Hazardous Waste Management" and DENR AO 36, series of 2004 that all waste generators are required to train their personnel and staff according to the training requirements stated on the procedural manual provided.

Strict implementation of the OHS Plan in the City in 2021 for the guidance of waste service personnel as stipulated on NSWMC Resolution 1364 is Implemented and obtained a weighted mean of 3.73 based on the data acquired from the respondents. They stated that general rules on reduction of hazards, control of processes, use of PPEs, marking of containers, and other rules provided in Rule 1090 of Occupational Health and Safety Standards of Department of Labor and Employment 1989 as amended are undertaken to lessen the possibility of health risks among the waste service personnel. A safety seal was also awarded to the respondents by the DILG through its Memorandum Circular No. 2021-053 affirming that their respective barangay follows safety and health protocols against COVID-19. Hence, most of the safety seals posted on their respective barangay halls were already

expired and some of them will expire within 2022. Safety seals issued by the DILG have only one (1) year of validity for renewal upon inspection of regulatory officers assigned.

It concludes on this provision of NSWMC Resolution item 1.5 Occupational Health and Safety for the Management of COVID-19 related Healthcare Waste in the City of Tarlac in 2021 is Implemented through the data gathered from the respondents by the researcher. Moreover, no incident was reported related to COVID-19 infection among the waste service collectors acquired from work since precautionary measures were followed and undertaken in accordance with the existing laws, rules, and regulations of the government.

Overall Evaluation of the Management of COVID-19 Related Health Care Waste in the City of Tarlac

The overall result of this study determined the evaluation of the Management of COVID-19 related Health Care Waste in the City of Tarlac based on the data gathered from the respondents during the surge of the pandemic in 2021 and in accordance with the stipulated provisions on National Solid Waste Management Commission Resolution No. 1364, series of 2020.

Table 7
Overall Evaluation

Indicators	Grand Mean	Adjectival Rating
Waste Generation	4.10	Implemented
Segregation and Storage at Source	3.49	Implemented
Collection and Transport	3.60	Implemented
Treatment and Disposal	3.64	Implemented
Occupational Health and Safety	4.15	Implemented
OVERALL GRAND MEAN	3.79	Implemented

It can be seen from table 7 that Occupational Health and Safety obtained a grand mean of 4.15 with an Adjectival Rating of Implemented. Truly, the LGU of Tarlac City through its Officials values the safety and welfare of its waste collection personnel during the coronavirus disease pandemic in 2021. Waste collection personnel plays a vital role in the City Waste Management System of a local government unit as they are the one who is responsible for the collection and transport of solid waste generated from the different households within the City. This also affirmed that waste collection personnel of the LGU follows the prescribed guidelines issued by concerned governing agencies inclined with the management of COVID-19 health care waste during the pandemic in 2021 in the City of Tarlac.

Moreover, collection of waste generation as to the composition of COVID-19 health care waste stated on NSWMC Resolution is Implemented in the City of Tarlac in 2021 which attained a grand mean of 4.10. It can be extracted from the analysis of waste generation that a total of 2,213 kilograms of sharp infectious waste was accumulated during the pandemic in 2021 in the City of Tarlac. Other COVID-19 related health care waste identified by the respondents was also collected from the different households, offices, establishments, and Barangay Health Centers/RHUs including the disposable PPEs used by the waste collection personnel of the LGU during the collection and transport of waste generated. This exhibit that COVID-19 related health care waste generation as to the classification of wastes regardless of their origin was properly collected during the pandemic in 2021. Hence, this excludes COVID-19 related health care waste generated from the different private and public hospitals situated in the City of Tarlac as the present study focuses on waste collected, transported, and treated by the LGU's waste service provider only.

It can also be gleaned from the table that proper Treatment and Disposal of COVID-19 related health care waste in the City of Tarlac in 2021 attained a grand mean of 3.64 with an Adjectival Rating of Implemented based on the specified guidelines issued by the NSWMC. Autoclave sterilization, a thermal process, indicated in the list of the approved treatment process with regard to the treatment of infectious and possible contaminated waste was used by the waste service provider of the LGU for the treatment of COVID-19 related infectious waste generated in 2021. After the treatment process, these wastes were disposed of in a container prior to the final disposal at the provided sanitary landfill of the LGU. This concludes that the LGU of Tarlac City and partner waste service provider act in accordance with the guidelines stated in the resolution issued by the NSWMC and other existing regulations pertaining to the implementation of such measures to ensure the safety of involved personnel and to lessen the possible degradation of the environment.

Further, the Collection and Transport of COVID-19 related Health Care Waste in the City of Tarlac during the outbreak of coronavirus disease infection in 2021 is Implemented and attained a grand mean of 3.60 based on the data consolidated from the respondents as they evaluate based on the legal basis from the NSWMC. This is due to the conduct of simultaneous orientation and training to waste collection personnel of the LGU with regards to the classification and management of infectious wastes associated with COVID-19 and in compliance with the existing protocols imposed to avoid possible health risks among the waste collection workers and waste generators during the conduct of collection. However, manual sorting which is prohibited under these guidelines was moderately implemented on smaller types of collection trucks as waste generators do not put labels as to the classification of waste being disposed of. This infers that even though some of the stated provisions on the NSWMC resolution were moderately implemented, most of it was compliant with the collection and transport regulations prescribed by the issuing agency.

As represented in table 7, Segregation and Storage at Source gained a grand mean of 3.49 with an adjectival rating of Implemented based on the evaluation of the respondents on the measures provided on NSWMC resolution. This revealed that during the COVID-19 infection outbreak in 2021, waste generators implemented proper waste segregation to ensure that COVID-19 related health care waste is not mixed with other domestic solid waste. However, since the availability of container bins and plastic bags is present, it is not compliant with the NSWMC resolution that "yellow" plastic bags and container bins must be used in accordance with the classification of waste being disposed of categorized as "infectious". Furthermore, some of the measures evaluated by the

respondents as to the interim guidelines on the management of COVID-19 related health care waste specifically on segregation and storage were followed.

Overall, the National Solid Waste Management Commission Resolution No. 1364, series of 2020 with its specific guidelines on the Management of COVID-19 Related Health Care Waste in the City of Tarlac in 2021 was Implemented with an Overall Grand Mean of 3.79 based on the evaluation of Barangay Officials/Committee on Solid Waste Management, Barangay Health Center Personnel, City ENR Officer and staff, City Health Officer, CHO Environmental Sanitation Officer, and Environmental Monitoring Officer of EMB at DENR-PENRO as the identified respondents of this study. This also concludes that the efficient and effective implementation of existing policies by the LGU of Tarlac City prevented any possible health risks that may arise associated with COVID-19. Briefly, the compliance of concerned Officials has a huge impact on the safer and easier execution of such guidelines issued by the national government during the time of pandemic in 2021.

2. Problems encountered by B/LGUs in the Management of COVID-19 related Healthcare Waste

The COVID-19 epidemic had a significant impact on the quality and quantity of trash produced, including City Solid Wastes and medical wastes. As a result of the government's lockdown, there may be changes in the source and volume of solid waste generated. It is important to note that the COVID-19 pandemic had a significant impact on current solid waste management methods. COVID-19 wastes must be treated and processed utilizing the existing infectious and healthcare waste management methods whenever practicable, as recommended by national or international standards. Medical waste management is difficult and complicated, especially in circumstances like the COVID-19 outbreak. Due to the sheer widespread of the pandemic's peculiarity, modifying current waste facilities to regulate the unusual medical waste and its corresponding viral spread effect requires accurate data on the amount of medical waste generated, waste hot spots, and treatment facilities. The present rapid increase in healthcare waste due to the COVID-19 pandemic is creating more problems, and there is an imminent threat that the consequences of unsafe healthcare waste disposal will spill over into a severe environmental crisis. By using appropriate waste management techniques and procedures for current treatment and disposal, such as decentralized solid waste and its integration, the negative consequences can be lessened. Additionally, the issues raised and identified by the respondents during the pandemic in 2021 will aid in the evaluation of COVID-19 related healthcare waste management in the City of Tarlac and the formulation of effective interventions and issuance of appropriate ordinances and resolutions to address emerging issues identified by the respondents.

Table 8
Problems Encountered by B/LGUs on the Management of COVID-19 related Healthcare Waste

	f	%	Ranking
Unavailability of facilities for the disposal of COVID-19 related health care wastes.	185	89%	1
Insufficient machinery and equipment for the treatment of COVID-19 related health care wastes.	179	86%	2
Unavailability of trash bins solely for COVID-19 related health care waste.	178	85%	3
Unavailability of disinfectants for COVID-19 related health care wastes.	165	79%	4
No budget allocation for the Management of COVID-19 health care waste.	145	69%	5
Insufficient presence of posters and/or billboards with regards to the Management of COVID-19 related health care waste.	135	65%	6
Insufficiency in the conduct of orientation and training to waste service providers on Occupational Health and Safety including a description of hazards in the workplace, environment, and community.	130	62%	7
Lack of strict enforcement in the implementation of the Management of COVID-19 related health care waste.	128	61%	8
Insufficiency in the implementation of Occupational Health and Safety Plan.	123	38%	9
Limited conduct of Information, Education, and Communication campaign within the communities/barangays.	112	34%	10

It can be seen from Table 7 that the unavailability of facilities for COVID-19 related healthcare wastes ranked first among the problems identified by the respondents with a percentage of 89. According to the respondents, though the designated facility was operational on the City level, it cannot accommodate simultaneous wastes generated from COVID-19 to avoid spillage and possible contamination within the site. They also stated that there is a limit on the collection of such wastes to prevent other

precautions on the facility and for them to have ample time to coordinate with the waste service provider for collection prior to treatment. Moreover, this problem concerns more on barangay levels to avoid mixing COVID-19 healthcare wastes with other residual and domestic wastes.

Ranked 2, with 86%, is the insufficiency of equipment and machinery for the treatment of COVID-19 related healthcare wastes. Based on the data gathered, barangays located kilometers away from the City proper with low internal revenue allotment has no available COVID-19 equipment for the treatment of COVID-19 healthcare wastes. They also added that such wastes generated during the pandemic in 2021 on vaccination programs within their barangays were collected by the City ENRO for transport at the designated facility of the LGU.

At rank 3, the problem of unavailability of trash bins solely for COVID-19 related healthcare wastes was also identified by some of the respondents having a percentage of 85. During the conduct of the interview, the availability of trash bins exclusively for facemasks and other related COVID-19 healthcare wastes was accessible in barangay halls. However, the respondents added that in households, facemasks were usually discarded with other domestic wastes due to the above-cited identified problem and lack of discipline in the community.

Respondents also identified that the unavailability of disinfectants for COVID-19 related healthcare waste is also a problem being faced on the barangay level, ranked fourth with 79%. They also stated that no one is expecting that this pandemic will change almost everything, yet, some of the barangays do not have enough funds for procurement of COVID-19 essentials. Requesting from the LGU is the easiest and fastest way that took 1 to 2 days since many barangays and other establishments were also requesting during the surge of the virus in 2021. In-kind donations from their constituents and other politicians were also observed, hence, it is not enough to sustain the need for disinfectants to be used within their community to ensure that sanitation is properly managed.

Ranking fifth, no budget allocation for Management of COVID-19 related Healthcare wastes was also identified by the respondents as a problem having a percentage of 69. Respondents stated that there was no specified budget allotment for the management of COVID-19 healthcare wastes, especially on barangays, wherein basic necessity such as food packs during the pandemic in 2021 was prioritized. If there's any, it was obtained from in-kind salary donations of barangay officials and from benevolent individuals.

Insufficiency in the presence of posters and other materials regarding the proper management of COVID-19 healthcare waste was also identified by some of the respondents as a problem ranking at sixth with 65%. Though minimum requirements on COVID-19 protocols were posted on barangay halls, the presence of posters on the appropriate management of these COVID-19 associated waste was minimal in their barangay jurisdiction resulting in a low level of awareness of the proper management of such healthcare wastes. They also added that even though these guidelines were posted on different social media platforms, some members of the community still do not follow them.

At rank seven (7), insufficient conduct of orientation and training to waste service collectors on OHS including a description of hazards in the workplace, environment, and the community still identified as one of the problems in the management of COVID-19 healthcare waste with a percentage of 62%. The respondents stated that only selected barangay officials and mostly BHWs were sent to attend the said orientation and training due to limited slots. They also added that they wish to participate in such activities for more additional information to be shared with their communities.

Ranking at eight (8), with 61%, lack of strict enforcement in the implementation of the management of COVID-19 related healthcare waste was also identified by some of the respondents on the problems being faced by their barangays as a result of lack of discipline on some households within their community on the proper waste segregation and due to large population on some barangays within the City Central Business District and nearby barangays from the City proper.

Some of the respondents still identified insufficiency in the implementation of the OHS Plan as one of the issues in the management of COVID healthcare wastes ranking ninth, with 38%. Though OHS was Implemented on the City level, some respondents stated that they have no enough information with regards to the proper administration of health and safety plans among their waste collectors since this is the first time that they have experienced an epidemic.

Ranked 10, were limited conducted IEC campaigns within their communities/barangays were also identified as a problem of some respondents having 34%. They added that IEC campaigns were mostly conducted in the City proper and via online wherein limited or selected officials were able to attend and participate.

Further, since the respondents were located in the different barangays within the City of Tarlac, identified problems were based on their experiences during the COVID-19 pandemic in 2021.

3. Proposed measures to enhance the Management of COVID-19 related Healthcare Waste

COVID-19 has had a significant effect on every aspect of our community, including waste management. Because waste management in developing countries is typically not conducted in accordance with international standards, there has been an increase in the amount of potentially infected waste, necessitating additional, careful handling and treatment processes. Guidelines on waste management have already been issued by the national government, however, those guidelines are aimed specifically at the current state of a developing country, like the Philippines. Furthermore, most of those available guidelines were created when the community is under normal conditions, and less in the midst of a pandemic. Under such circumstances, Tarlac City LGU must respond to COVID-19 and find a solution for themselves. Finding a universal landing point between desirable and affordable goals is difficult, which is why setting individual goals is left to the discretion of the LGU.

Moreover, identified proposed measures and strategies by the researcher to enhance the management of COVID-19 related healthcare wastes in the City of Tarlac will definitely contribute to the planning, monitoring, and evaluation of the LGU on the existing waste management and for possible funding of these activities for implementation and execution which will have a huge impact on the community to lessen the health risks that may occur and to the environment to prevent pollution in all aspect and most especially to alleviate the lives of Tarlaquenos even in time of the pandemic.

Table 8
Proposed Measures to enhance the Management of COVID-19
related Healthcare Waste in the City of Tarlac

Indicators	Proposed Measures	Objectives	Strategies	Expected Outcome
Segregation and Storage At Source	Identification of possible disposal facilities on the barangay level for COVID-19 related health care waste must be conducted and facilitated by concerned officials.	To lessen the roaming of waste collection trucks on the streets containing the wastes collected in every household and for the members of the community to dispose of their COVID-19 associated health care waste on the identified designated facility.	Set a schedule for the disposal thrice or twice a week to avoid possible contamination with other wastes being disposed of and to prevent any risks from the barangay officials concerned.	Waste collection personnel will automatically proceed to the identified disposal facility of the barangay for the collection of accumulated health care wastes related to COVID without any roaming needed from house to house.
Segregation and Storage At Source	Provision of “yellow” trash bins or containers solely for COVID-19-related health care waste.	To make sure that COVID-19 related health care waste categorized as “hazardous /infectious waste” was discarded on appropriate trash bins in accordance with NSWMC Resolution.	Systemize the provision of yellow trash bins mainly on barangays located in the City proper and within the City Central Business District where the bulk of wastes was generated.	Through this measure, COVID-19 related health care waste generated from different barangays was expected already to be classified prior to the collection of waste workers to lessen the potential risks that they might get from it.
Segregation and Storage At Source	The LGU may install additional billboards and posters in accordance with the proper waste management of COVID-19-associated waste during this pandemic. Posting to social media platforms will also reach many social media users of different ages.	To make certain that the member of the community is aware of the existing guidelines on the management of COVID-19 related health care waste issued by the National Solid Waste Management Commission.	These posters and billboards must be installed and posted more in public places such as amusement parks, malls, supermarkets, churches, and waiting sheds where it is often the direction of most people.	Segregation at source where most of the bulk of solid waste was generated at households, this measure has a huge potential impact to start the proper waste segregation in their own households for much easier collection and to prevent pollution to the environment.
Segregation and Storage At Source	Formulate or adopt pertinent resolutions on the management of COVID-19 related health care waste to strengthen the political will of Officials on the strict enforcement and implementation of proper waste management in their area of jurisdiction.	To the members of their respective communities to follow and obey the regulations issued by the national government with regard to the management of COVID-19 related health care waste.	Tarlaqueños who do not comply with the existing regulations imposed as to the proper management of COVID-19 associated wastes must have appropriate disciplinary action such as community service and participation in	The identified measure will encourage more Tarlaqueños to practice proper waste management not only during these times of the pandemic but most especially during the segregation of their daily domestic wastes generated from households.

			the conduct of IEC by the LGU or NGAs to their respective barangay.	
Segregation and Storage At Source	Intensify the conduct of Information, Education, and Communication campaigns regarding the Management of COVID-19 Related Health Care Waste at the Barangay level.	To make the officials most especially on the barangay level and for the community to be aware of the existing guidelines issued and the possible hazard associated with such wastes that might cause health problems and pollution to the environment.	Conduct IEC campaigns once every quarter or as much as possible coordinate with DENR through its PENR and CENR Offices for better discussion and emphasis on the proper waste management.	Through these, implementation of such guidelines will be more effectively executed, and encouraging the community to participate in these activities will waken their awareness of this pressing issue for them to be vigilant in their actions most especially in waste management.
Collection and Transport	Additional budget allocation for the management of COVID-19 related health care waste must be considered besides the emergency funds currently being utilized.	To ensure that all COVID-19 related health care waste was collected, transported, and disposed of in line with the prescribed guidelines issued by the NSWMC and not to hamper the operationalization of waste collection during this times of pandemic.	Create a COVID-19 waste management plan based on the issued NSWMC Resolution for possible inclusion in the budget proposal of LGU.	Sufficient budget allocation will support the whole implementation of the COVID-19 waste management plan to guarantee that all generated possible infectious waste during the pandemic was collected and properly disposed of.
Treatment and Disposal	Procurement of additional low-cost disinfectants for COVID-19 related health care waste.	To guarantee that upon collection of COVID-19-associated wastes, disinfection was conducted to prevent any possible health risks to occur prior to transport of waste service provider.	The LGU may prioritize or consider possible budget allocation for the procurement of low-cost disinfectants to be used for wastes accumulated from COVID-19-positive patients from quarantine facilities or households.	This measure will prevent the spread of the virus most especially within the community and it will also secure the safety of waste workers personnel during the scheduled collection.
Treatment and Disposal	The LGU may perchance allocate funds for procurement of machinery and equipment for the treatment of COVID-19 related health care waste if collection and transport were already hampering the service from the waste service provider.	To conduct an appropriate treatment process for the collected COVID-19 related health care waste immediately after the collection activities by the waste collection personnel.	Conduct assessment on the current situation of COVID-19 cases in the City and evaluate the processing of required documents needed prior to transport of waste service provider to determine if this proposed measure identified is urgently needed.	Once approved, all collected infectious waste generated from different vaccination drives and not only those COVID-19 associated health care waste will also be treated straight away after collection.

Occupational Health and Safety	Strict implementation of Occupational Health and Safety Plan among the City LGU waste workers involved in the collection of COVID-19 related health care waste.	To prevent the waste collection personnel and waste generators from any possible health risks that may occur during the conduct of collection and transport of wastes associated with COVID.	Continuous conduct of orientation and training to waste collection personnel most especially those who are newly-hired for them to have enough knowledge on the proper waste management system.	This measure will help the waste collection personnel of LGU to be more familiar with the classifications of waste to be collected and with the proper handling in accordance with the prescribed guidelines stipulated in HCWM Manual for much safer working conditions.
Occupational Health and Safety	Provide appropriate orientation and training with regards to the management of COVID-19 associated waste to waste collection personnel and extend the conduct to the barangay level.	To gain sufficient and accurate information and knowledge on the proper waste management, especially on the description of hazards in the workplace and their possible effect on the environment and the community.	Waste collection personnel and barangay officials or the committee on solid waste must have a scheduled waste management training once per semester to equip their skills and for them to raise emerging concerns as to the management of solid waste and possible infectious waste related to COVID-19.	Since the concerned barangay officials and waste workers will be equipped on the waste management through this orientation and training, this measure will prevent health risks that might happen during the collection activities, possible environmental degradation will also be avoided, and the assurance of the safety and welfare of the community will be attained.

It can be seen from Table 8 are the proposed measures to enhance the Management of COVID-19 related health care waste in the City of Tarlac. Identification of possible disposal facilities on the barangay level is one of the identified proposed measures to lessen the roaming of collection vehicles containing the collected wastes in every household and for the members of the community to dispose of their COVID-19 associated health care waste on the identified designated facility. Further, setting of schedule for the disposal to avoid possible contamination with other wastes being disposed of and to prevent any risks from the barangay officials concerned was also identified as a strategy. Through these, waste collection personnel will no longer be needed to conduct house-to-house collection where they can automatically proceed to the identified facility of the barangay for the collection and transport of accumulated waste.

Provision of “yellow” trash bins or containers solely for COVID-19 related health care waste was also identified as a proposed measure by the researcher. This is to make sure that COVID-19 related health care waste categorized as “hazardous or infectious waste” was disposed of in appropriate trash bins in accordance with the NSWMC resolution. The systematic provision of yellow trash bins mainly on barangays situated in the City proper or within the City Central Business District where the bulk of waste was most generated was identified as the strategy to enhance the management of COVID-19 related health care waste in the City of Tarlac. Through this measure, generated COVID-19 associated wastes generated from the barangays were expected already to be classified prior to the collection of waste collection personnel to lessen the potential risks that they might get from it.

Among the proposed measures, the LGU may also consider installing additional billboards and posters in relation to the proper waste management of COVID-19 related health care waste during this time of pandemic and posting to social media platforms which will engage many social media users of different ages. Through these, the community will be aware of the existing guidelines on the management of COVID-19 related health care waste issued by the NSWMC. These posters and billboards may be installed and posted more in public places where it is often the direction of most people. This measure has a huge potential impact to start the proper waste segregation in their own households for much easier collection and to prevent pollution to the environment.

For the members of the community to follow and obey the regulations issued by the national government with regard to the management of COVID-19 related health care waste, formulation or adoption of resolutions as to the management of COVID-19 related health care waste to strengthen the political will of the officials on the strict enforcement and implementation of proper waste management within their area of jurisdiction was also identified as a proposed measure by the researcher. Tarlaqueños who do not comply with the existing regulations imposed by the government as to the proper management of COVID-19 associated wastes must have appropriate disciplinary action such as community service and participation in the conduct of IEC by the LGU or NGAs to their respective barangays. Identified measures will encourage more Tarlaqueños to practice proper waste management

not only during this time of the pandemic but most especially during the segregation of their daily domestic wastes generated every day.

Furthermore, for the members of the community to be aware of the existing guidelines issued and the possible hazard associated with them that might cause health problems and pollution to the environment, intensify the conduct of Information, Education, and Communication campaigns regarding this pressing issue on the management of COVID-19 related health care waste at the barangay level was also included on the proposed measures identified by the researcher. Conduct EIC campaigns once every quarter or as much as possible coordinate with DENR through its Provincial Environment and Natural Resources Office and Community Environment and Natural Resources Offices to conduct awareness campaigns for better discussion and emphasis on the proper waste management. Through these, implementation of such guidelines will be more effectively executed by encouraging the community to participate in these activities to awaken their awareness of this compelling issue for them to be more vigilant in their actions most especially in waste management.

To further enhance the management of COVID-19 related health care waste, an additional budget allocation may also be considered to ensure that all accumulated COVID-19 related health care waste was collected, transported, and disposed of in line with the prescribed guidelines issued by the NSWMC and not hamper the operationalization of waste collection during this times of pandemic. The creation of COVID-19 waste management plan based on the issued resolution for possible inclusion in the budget proposal of LGU was also seen as a strategy to enhance the management of COVID-19 related health care waste. Sufficient budget allocation will support the whole implementation of COVID-19 waste management plan to guarantee that all generated possible infectious waste during the pandemic was collected and properly disposed of.

The proposed identified measure also includes the procurement of additional low-cost disinfectants for COVID-19 related health care waste to guarantee that upon collection of COVID-19 associated wastes, disinfection was conducted to avoid any possible health risks that may arise prior to transport of waste service provider. For this measure to be effectively implemented, the LGU may prioritize or consider possible budget allocation for the procurement of disinfectants to be used for wastes accumulated from COVID-19 positive patients from quarantine facilities or households. This measure will surely prevent the spread of the virus most especially within the community and it will also secure the safety of waste workers during the scheduled collection.

It can also be gleaned from the table that possible budget allocation for the procurement of machinery and equipment for the treatment of COVID-19 related health care waste was also identified as a proposed measure if collection and transport were already hampering the service from the waste service provider. This measure will be able to facilitate immediately the conduct of treatment process to the collected COVID-19 related health care wastes. Moreover, conducting a thorough assessment and evaluation of LGU as to the current situation of the COVID-19 pandemic in the City and the processing of required documents needed prior to transport of waste service provider will determine if this identified proposed measure is urgently needed to be undertaken. Hence, once approved, all collected and generated infectious waste from different vaccination drives and not only exclusively for those waste associated with COVID-19 will also be treated right away after collection.

It can also be seen from the table that the provision of appropriate orientation and training in line with the management of COVID-19 related health care waste to waste collection personnel up to the barangay level was also identified as a proposed measure for them to gain sufficient and accurate information and knowledge on the proper waste management, especially on the description of hazards in the workplace and their possible effect on the environment and to the community. Schedule waste management training once per semester will help to equip the skills of waste collection personnel and for able to raise emerging concerns as to the management of solid waste and possible infectious waste related to COVID-19. This measure will prevent health risks that might happen during the collection activities, possible environmental degradation will also be avoided, and the assurance of the safety and welfare of the community will be attained.

Strict implementation of the OHS plan among the City LGU waste workers involved in the collection of COVID-19 related health care waste was also identified by the researcher as a proposed measure to enhance the management of COVID-19 associated health care waste in the City of Tarlac. Through this, it will prevent the waste collection personnel and waste generators from any possible health risks that may occur during the conduct of collection and transport of wastes associated with COVID. Continuous conduct of orientation and training to waste collection personnel most especially those who are newly-hired was identified as an approach by the researcher for them to have enough knowledge on the proper waste management system. This measure will help the waste collection personnel of LGU to be more familiar with the classifications of waste being collected and with the proper handling in accordance with the prescribed guidelines stipulated in HCWM Manual for much safer working conditions.

Therefore, identified proposed measures by the researcher may help the Local Government Unit and officials to enhance the management of COVID-19 related health care waste in the City of Tarlac in accordance with the National Solid Waste Management Commission Resolution No. 1364, series of 2020, and other existing rules and regulations issued by the government as to the management of potentially infectious wastes associated with COVID. Through these, it will alleviate the living conditions of Tarlaqueños not only in this time of pandemic but most especially in their daily living.

3. Implications of the study to Public Administration

Since the SARS-CoV-2 outbreak, there is a spike in the volume of dumped single-use surgical and face masks, as well as non-sterile gloves, found littering streets and roads, healthcare centers, parking spaces, landfills, shorelines, and even sewer lines. Many COVID-19 related healthcare wastes pose a direct health risk to anyone who comes into contact with them. Improper waste management can have an impact on humans through drinking water and food consumption that may result in health risks associated with coronavirus. If potentially infectious or contaminated waste is not properly disposed of, it can easily enter the environment at an undesirable rate posing a pressing issue on pollution and conservation of biodiversity.

The National Solid Waste Management Commission under the Office of the President chaired by the Department of Environment and Natural Resources which is the head government agency that looks after the welfare of our environment in coordination with the Local Government Units thru its ordinances and resolutions must spearhead the provision of relevant and appropriate pieces of information on the proper waste management of potentially infectious and contaminated wastes accumulated from COVID-19 to the public which is beneficial not only for our environment but more especially to our community to avoid uncertain risks. Further, LGU and Barangay Officials must also be equipped and knowledgeable enough on the existing laws, policies, ordinances, and guidelines that the government imposes for a systemized implementation of these directives and certain restrictions to lessen the potential hazard brought by the improper management of COVID-19 related healthcare wastes in the City

of Tarlac. Moreover, the researcher must identify the problems encountered and proposed measures by LGU and Barangay Officials that will serve as a guide for the researcher to conclude on the present status of managing COVID-19 related healthcare wastes in the City.

The Sustainable Development Goals (SDGs) include waste management either explicitly or implicitly in more than half of the 17 goals, demonstrating how deeply ingrained it is in the SDGs. Therefore, there is a compelling case for the strategic significance of improving waste management during this times of the pandemic, given that doing so will advance majority of SDG targets.

The findings that the researcher obtained in this study will give ideas and may help the Barangays and the Local Government Unit of Tarlac City to frame their decisions on the strict implementation of waste management during this time of the pandemic in accordance with National Solid Waste Management Commission Resolution No. 1364, series of 2020 and on Republic Act No. 9003 or the Ecological Solid Waste Management Act of 2000 and other related laws and policies. On the other hand, one of the major findings of the present study was most of the specific guidelines provided in the NSWMC Resolution were Implemented in the City of Tarlac which is a good indicator that Officials implemented the directives issued by the national government during the pandemic in 2021.

The NSWMC, DENR-EMB, and B/LGUs may use this research as a tool in order to assess the identified problems and possible interventions to be undertaken for them to develop, and deliver public programs or services, inform policy-making, and provide humane services to the public interest. Therefore, through the evaluation of the implementation of the guidelines issued by the NSWMC in the City of Tarlac, this research might serve as insight on crafting new policies, ordinances, guidelines, and resolutions to address this pressing issue on waste management.

XV. SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Findings

1. Based on the documentary analysis and data gathered from the respondents, the collection of COVID-19 related health care waste in the City of Tarlac is Implemented during the pandemic in 2021. A total of 2,213 kilograms of sharp infectious wastes were accumulated from the different households, establishments, and Barangay Health Centers/RHUs in the City composed of syringes, needles, and vials of vaccine from the period of January to October 2021. Other COVID-19 related health care waste such as disposable PPEs including facemasks, face shields, non-sterile gloves, footwear, and other protective health gear including coverall gears of waste collectors was also collected, disposed and separated with sharp infectious waste.
2. Specified guidelines on segregation and storage at source were also Implemented, however, proper waste segregation at households to ensure that COVID-19 related health care waste is not mixed with other domestic waste is Moderately Implemented due to the fact that most of the barangays have no MRF the same with the guidelines that container bins with labels must be closed and not too full during handling of such waste. Further, infectious wastes stored in yellow plastic bags/container bins with labels were also Moderately Implemented based on the data gathered.
3. Regular disinfection/sanitizing activities for collection vehicles and equipment, including facilities are Highly Implemented in 2021 in the City. Hence, the collection and transport of potentially infectious and contaminated healthcare waste associated with COVID in a separate container within the collection vehicles were Moderately Implemented due to the mixing of healthcare waste generated from households with other domestic waste. Moreover, prohibiting manual sorting of wastes in collection vehicles and disposal facilities was also Moderately Implemented due to some containers having no labels as to the classification of waste in accordance with NSWMC resolution.
4. Autoclave sterilization is used by the waste service provider of Tarlac City in treating COVID-19 related healthcare wastes acquired from the storage facility of LGU which is an approved process for treatment of infectious and contaminated wastes based on the existing Joint DAO of DENR and DOH. This thermal process also complies with treatment efficacy based on HCWM of DOH.
5. Metro Clark Waste Management Corporation is the Philippines'only approved sanitary landfill operator that is ISO certified for management, environmental compliance, and OHS located at Brgy. Calangitan, Brgy. Cut-Cut I, Capas, Tarlac where health care waste generated from COVID-19 and other domestic waste from households were transported from Tarlac City were disposed of hereto after treatment.
6. Availability of disinfectants and hand sanitizers in every collection vehicle was Highly Implemented in 2021 as well as observance of basic hygiene practices to reduce risks and protect waste collectors against illness due to infectious waste they may acquire from coronavirus disease.
7. No incident of positive COVID-19 case and other severe health concerns was reported among waste collectors in the City acquired from work in 2021.
8. Unavailability of facilities mostly at the barangay level for the disposal of COVID-19 related health care waste topped among the identified problems by the respondents on the management of COVID-19 related health care waste followed by insufficiency of machinery and equipment for treatment due to lack of budget allocation and unavailability of funds.
9. Since the LGU has no specific ordinance and/or adoption of NSWMC resolution, formulation of an exclusive ordinance on the management of COVID-19 related health care waste was identified measure of the researcher the same with provision of appropriate trash bins solely for COVID waste in every offices and barangays.
10. Possible provision of collection vehicles was also identified as a proposed measure since not all the barangays, especially in the City proper, have their own collection vehicle.
11. The National Solid Waste Management Commission Resolution No. 1364, series of 2020 with the interim and specific guidelines stipulated herein is Implemented in the City of Tarlac during the pandemic in 2021 with an overall grand mean of 3.79.

Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. COVID-19 related health care waste generated from the City of Tarlac in the surge of coronavirus disease infection in 2021 composed of different PPEs such as but not limited to facemasks, non-sterile gloves, face shields, footwear, and other health-protective gear where the bulk of such wastes was accumulated and collected from the different households, testing centers, quarantine facilities, Barangay Health Centers/RHUs.
2. Segregation and storage at source guidelines specified on NSWMC resolution No. 1364 were Implemented in the City in 2021, hence, some of the provisions were Moderately Implemented due to a lack of information among Barangay Officials on the proper waste management and classification of waste being collected and due to lack of discipline among Tarlaqueños.
3. Particular specifications on collection and transport of COVID-19 related health care waste in the City of Tarlac are Implemented, yet, some are Moderately Implemented due to lack of strict enforcement of these guidelines to the community. In addition, safety preventative measures and concerns were managed for the sake of health hazards and technicalities that may affect garbage collectors and generators, as well as the waste service provider's operation.
4. Treatment and disposal guidelines stipulated in the provided resolution were also Implemented in the City of Tarlac in 2021 specifically on the stated measures to be undertaken as to the availability of technologies, treatment efficacy, and other technicalities in the execution of these activities. This is due to the compliance of B/LGUs Officials with the directives issued by concerned regulatory agencies with regard to the standards prescribed by the national government.
5. Being the only approved sanitary landfill operator in the Philippines that is certified by International Organization for Standardization for its management, environmental compliance, and OHS, which operates the first and most advanced engineered sanitary landfill in the country, the Metro Clark Landfill served as the sanitary landfill of Tarlac City LGU with regards to the disposition of COVID-19 related health care waste after treatment of partner waste service provider during the pandemic in 2021.
6. Accessibility to disinfectants and hand sanitizers in every collection vehicle was Highly Implemented in 2021 due to the prioritization of LGU for its procurement and also made possible with the in-kind donation of Tarlaqueños to avoid possible health risks among the waste collectors and generators.
7. NSWMC Resolution item 1.5 on Occupational Health and Safety concludes that the Management of COVID-19 related Health Care Waste in the City of Tarlac in 2021 is Implemented. Nonetheless, as preventive measures were followed and completed in line with the government's existing laws, rules, and regulations, no instance involving COVID-19 infection among garbage service collectors acquired from work has been recorded.
8. Unavailability of COVID-19 related health care waste facilities mostly in barangay levels topped the identified problems by the respondents considering that most of the barangays in the City of Tarlac have no enough budget allocation for this activity to be undertaken.
9. Even if there is no specific ordinance and/or adoption of NSWMC resolution was made in 2021 in connection with the Management of COVID-19 related health care waste in the City of Tarlac, specified guidelines were complied based on the evaluation of data acquired from the respondents.
10. Possible provision of collection vehicles was also identified by the researcher as a proposed measure for the collection of solid waste not only intended for those COVID-19 related health care waste generated during this times of the pandemic but most especially for collection of domestic waste acquired from every household every day.
11. Moreover, based on the researcher's analysis and evaluation of the information collected from the respondents, stipulated guidelines on the Management of COVID-19 Related Health Care Waste in the City of Tarlac were Implemented even though there is no existing ordinance or adoption of NSWMC Resolution 1364 made by the LGU in 2021.

Recommendations

Based on the findings and conclusions of the study, the following recommendations were derived.

1. The LGU through the CENR Office must continue the collection of COVID-19 related health care waste acquired from different vaccination programs conducted in their barangays the same as other COVID related healthcare waste such as facemasks acquired from households to prevent possible health risks and huge potential impact of pollution on the environment.
2. With the help of national government agencies, concerned offices must intensify the conduct of Information, Education, and Communication campaigns on proper waste management most especially at the barangay level specifically in barangays located within the City proper where the bulk of waste was accumulated, for more efficient and effective implementation in the communities within the City. Collaboration and coordination with NGAs and the academe will also have a huge impact on information dissemination on proper waste management not only concerning COVID-19 related healthcare waste but also the residual waste and domestic wastes generated every day in the different households in the City.
3. Strengthen the enforcement of collection and transport in accordance with NSWMC Resolution through the conduct of orientation and training for a better understanding of the existing protocol imposed by the authority.
4. Waste service provider of the LGU of Tarlac must continue to adhere to the provided policies of the government to ensure the safety of waste treaters and mostly to avoid the possible harmful effect on the environment.
5. Preventive measures provided on the OHS plan of the LGU should be administered carefully to elude the risks that may occur during performing the assigned task to waste collectors.
6. Identified problems by the respondents regarding the unavailability of facilities for the management of COVID-19 related health care waste may consider by the LGU for possible proposals and budget allocation to address the pressing issue of waste management not only in this times of pandemic.
7. Provision of "yellow" trash bins or containers solely for COVID-19 related health care waste and other infectious waste is highly recommended to avoid possible risks with the waste collection personnel during the scheduled collection on their respective barangays.

8. Material Recovery Facility in every barangay must be available to recover recyclable materials generated from households and for easy classification of solid waste prior to the collection of LGU to prevent mixing of domestic waste to possible contaminated waste associated with COVID.
9. Posting additional posters or billboards in public places and on any social media platforms is highly recommended for the members of the community to be aware of the Management of COVID-19 related health care waste and the hazard associated with it.
10. The LGU must formulate or adopt a specific ordinance/resolution on the management of such waste for them to have a framework for the implementation of delicate cases particularly on the management of possible infectious or contaminated healthcare waste. In addition, thorough research shall be conducted to address the existing problems identified by the respondents to alleviate the living condition of Tarlaqueños.

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XVII. DEDICATION

The piece of work is
Lovingly and wholeheartedly
Dedicated to
My Family
Especially to my Grandparents,
Daniel F. Tolentino, Sr. & Ceferina P. Tolentino
Who has always been my refuge, my strength
And the source of inspiration
And to all those people who believed
And pushed me up when I'm tired and weak.

Balbaleg ya salamat ed sikayon amin!

REFERENCES

- [1] Acharya et. al (2021). *The Impact of COVID-19 Outbreak and Perceptions of People Towards Household Waste Management Chain in Nepal*
- [2] Apostol et. al (2020). *Occupational Risk Assessment of Municipal Solid Waste Collectors in a City Subdivision in the Philippines*
- [3] Benson et. al (2021). *COVID Pollution: Impact of COVID-19 Pandemic on Global Plastic Waste Footprint*
- [4] Cabico (2020). *Medical waste piles up as COVID-19 Cases Rises*
- [5] Cruz et. al (2016). *Healthcare Waste Management of the Government Hospitals in Northern Philippines*
- [6] Daryabeigi et. al (2020). *Emanating Challenges in Urban and Healthcare Waste Management in Isfahan, Iran after the Outbreak of COVID-19*
- [7] Das et. al (2021). *COVID-19 Pandemic and Healthcare Solid Waste Management Strategy*
- [8] Dybas (2021). *Surgical Masks on the Beach and Marine Plastic Pollution*
- [9] Ferronato & Torretta (2019). *Waste Mismanagement in Developing Countries: A Review of Global Issues*
- [10] Gumasing and Sasot (2019). *An Occupational Risk Analysis of Garbage Collection Tasks in the Philippines*

- [11] Hantoko et. al (2021). *Challenges and Practices in Waste Management and Disposal during COVID-19 Pandemic*
- [12] Ilyas et. al (2020). *Disinfection Technology and Strategies for COVID-19 Hospital and Bio-Medical Waste Management*
- [13] Islam et. al (2021). *Escalating SARS-CoV-2 Circulation in Environment and Tracking Waste Management in South Asia*
- [14] Limon et. al (2020). *Solid Waste Management Beliefs and Practices in Rural Households Towards Sustainable Development and Pro-Environment Citizenship*
- [15] Mariano and Matias (2019). *Prevalence of Symptoms and Risk Factors of Health Problems of Solid Waste Collectors in the Philippines*
- [16] Mejjad et. al (2021). *Disposal Behavior of Used Masks during the COVID-19 Pandemic in the Moroccan Community: Potential Environmental Impact*
- [17] Mekonnen et. al (2021). *Healthcare Waste Status and Handling Practices during COVID-19 Pandemic in Tepi General Hospital, Ethiopia*
- [18] Melaku and Tiruneh (2020). *Occupational Health Conditions and Associated Factors Among Municipal Solid Waste Collectors in Addis, Ababa, Ethiopia*
- [19] Mina (2015). *Case Studies on Health Care Waste Management Practices of Selected Public and Private Hospitals in Metro Manila*
- [20] Nguyen et. al (2021). *Estimation of COVID-19 Waste Generation and Composition in Vietnam for Pandemic Management*
- [21] Peng et. al (2021). *Plastic Waste release caused by COVID-19 and its fate in the Global Ocean*
- [22] Ravi et. al (2020). *Knowledge and Awareness on Usage of Mouth Masks Among Dental Fraternity during this Pandemic COVID-19: A Cross-Sectional Study*
- [23] Roberts et. al (2020). *Coronavirus Face Masks: An Environmental Disaster that might last Generations*
- [24] Sangkham (2020). *Face Mask and Medical Waste Disposal During the Novel COVID-19 Pandemic in Asia*
- [25] Selvaranjan et. al (2021). *Environmental Challenges Induced by Extensive Use of Face Masks During COVID-19: A Review and Potential Solutions*
- [26] Shams et. al (2021). *Plastic Pollution during COVID-19: Plastic Waste Directives and Its Long-Term Impact on the Environment*
- [27] Tirkolae et. al (2021). *A Sustainable Medical Waste Collection and Transportation Model for Pandemics*
- [28] Tripathi et. al (2020). *Challenges, Opportunities, and Progress in Solid Waste Management during COVID-19 Pandemic*
- [29] Vallente et. al (2020). *Unmasking Emerging Issues in Solid Waste Management: Knowledge and Self-Reported Practices on the Discarded Disposable Masks during the COVID-19 Pandemic in the Philippines*
- [30] Wang et. al, (2020). *Disinfection Technology of Hospital Wastes and Wastewater: Suggestions for Disinfection Strategy during Coronavirus Disease 2019 (COVID-19) Pandemic in China*
- [31] Zhu et. al, (2020). *A Review of Municipal Solid Waste in China: Characteristics, Composition, Influential Factors, and Treatment Technologies*

LEGAL BASES

- National Solid Waste Management Commission Resolution No. 1364, series of 2020 – Adopting Interim Guidelines on the Management of COVID-19 Related Healthcare Waste*
- Joint DENR-DOH Administrative Order No. 02, series of 2005 – Policies and Guidelines on Effective and Proper Handling, Collection, Transport, Treatment, Storage, and Disposal of Health Care Wastes*
- National Solid Waste Management Commission Resolution No. 1429, series of 2021 – Resolution Enjoining All National Government Agencies to Provide Yellow Bins in their Respective Premises for the Proper Storage of Household Health Care Wastes and to Coordinate with their Respective Local Government Units for the Collection, Transport, Treatment, and Disposal of such Wastes*
- Department of Labor and Employment - Occupational Safety and Health Standards (as amended, 1989)*
- Department of the Interior and Local Government Memorandum Circular No. 2020-147 – Guidelines on the Management of COVID-19 Related Health Care Waste*
- Department of the Interior and Local Government Memorandum Circular No. 2021-053 – Implementing Guidelines of the Safety Seal Certification Program for this Department and the Local Government Units as Issuing Authorities*
- Department of Health – Health Care Waste Manual*

WEB PAGES

- <https://emb.gov.ph>
- <https://nswmc.emb.gov.ph>
- <https://www.greenpeace.org>
- <https://www.who.int>
- <https://doh.gov.ph>
- <https://www.denr.gov.ph>
- <https://www.dilg.gov.ph>
- <https://www.sptarlaccity.net>