

Knowledge, Attitudes, and Practices on Biosafety among Filipino Registered Medical Technologists: A Comparative Study

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Abstract: - Despite growing awareness on biosafety practices and emergence of technological advancements, many provincial clinical laboratories in the Philippines continuously rely on manual methods of laboratory analysis, thereby increasing risk of exposure if biosafety protocols are not strictly enforced. Additionally, the pressing concern of COVID-19 has led to the development of stringent biosafety guidelines to protect laboratory personnel, such as Filipino registered medical technologists (RMTs), from occupational exposure to potentially infectious specimens. This study aimed at comparing the levels of knowledge, attitudes, and practices on biosafety, and application of COVID-19 biosafety protocols among Filipino RMTs working in private and public clinical laboratories in Bataan, Batangas, Bulacan, and Camarines Sur. This study was granted approval by the Faculty of Pharmacy Research Ethics Committee with the assigned reference number of FOP-REC-2021-01-155. Using a Descriptive-Comparative research design, a total of 244 Filipino RMTs selected through snowball sampling responded to an online questionnaire consisting of four main components: Knowledge Evaluation, Attitude Likert Scale, Practice Likert Scale, and COVID-19 Biosafety Likert Scale. Descriptive statistics and T-test with 95% confidence interval were utilized to analyze and interpret the data. There is no significant difference on the levels of knowledge ($p=0.359$), attitude ($p=0.567$), practice ($p=0.845$) and COVID-19 Biosafety application ($p=0.832$) among Filipino RMTs working in public and private clinical laboratories located in the research locale. Majority of the respondents demonstrated good knowledge on biosafety principles, commendable attitude towards biosafety, commendable practice of biosafety, and commendable application of COVID-19 biosafety protocols. The results of the study can raise awareness on the importance of building a strong safety culture within the respective workplaces of Filipino RMTs, present valuable information to further improve the pre-existing risk- and evidence-based approaches to biosafety, ensure the safety of the general public by the quality and reliability of biosafety practices, and provide an overview of the current status of biosafety knowledge, attitudes, and practices among Filipino registered medical technologists.

Key Words: — *Biosafety, Knowledge, Attitudes, Practices, COVID-19, Filipino registered medical technologists.*

I. INTRODUCTION

Biosafety generally refers to a framework that aims at protecting the workers, community, as well as the environment from potentially infectious and hazardous agents.^[1] This is done by establishing safety measures that significantly reduce the likelihood of acquiring infections and accidents.^[2]

In the Philippines, awareness on biosafety practices has greatly progressed throughout the years with the aid of technological advancements available to improve the quality of clinical laboratory service and to minimize laboratory workers' exposure to potentially infectious biologic agents. However, according to Lagman (2020), such modern set-ups are commonly observed in health facilities located in Metro Manila due to concentrated human health resources.^[3] Meanwhile, many provincial clinical laboratories still rely on manual methods of clinical laboratory tests, thereby increasing their risk of exposure if no strict enforcement of biosafety measures is done.

Manuscript revised August 17, 2021; accepted August 18, 2021. Date of publication August 20, 2021.
This paper available online at www.ijprse.com
ISSN (Online): 2582-7898

Despite differences in institutional standard operating procedures, both public and private provincial clinical laboratories are equally vulnerable to laboratory hazard exposure; hence, it is important to build a strong culture of safety in clinical laboratories anchored on the knowledge, attitudes, and practices on biosafety among Filipino registered medical technologists. The strict enforcement of biosafety is crucial to keep these workers safe from biological hazards during the COVID-19 pandemic.

The objectives of the study are to assess and compare the levels of knowledge, attitudes, and practices on biosafety, application of COVID 19 biosafety protocols among Filipino registered medical technologists working in public and private clinical laboratories located in the provinces of Bataan, Batangas, Bulacan, and Camarines Sur. For the null hypothesis, the study hypothesized that there is no significant difference in the levels of knowledge, attitudes, and practices on biosafety among Filipino registered medical technologists working in the research locale. On the other hand, the alternative hypothesis of the study would be having a significant difference in the levels of knowledge, attitude, and practices on biosafety.

This paper primarily focused on four variables: knowledge, attitude, and practice on biosafety, and application of COVID-19 biosafety protocols. The knowledge aspect focused on the level of awareness of Filipino registered medical technologists on standard biosafety practices in the clinical laboratory. The attitude part related to their feelings and preconceived ideas towards the implementation of biosafety practice. The practice variable pertained to the level of biosafety practices in their daily operations. Lastly, the application of COVID-19 biosafety protocols part dealt with observation of a safety culture in their respective clinical laboratories.

The study was limited to the biosafety practices among Filipino registered medical technologists working in public and private clinical laboratories located in the research locale. Thus, the only biosafety measures emphasized in the study include good laboratory work practices and procedures, personal protective equipment, safety equipment, waste disposal management, and laboratory design.

The study aimed at greatly benefiting the following populations: 1) Filipino registered medical technologists by raising awareness on the importance of establishing a strong safety culture within the workplace. Safety culture

encompasses the strict implementation of risk assessments, good microbiological practices and procedures (GMPP), standard operating procedures (SOPs), appropriate training, and prompt documentation and reporting of incidents and accidents to be succeeded by investigation and provision of corrective measures^[4], 2) other clinical laboratory personnel by presenting valuable information useful for the fortification of pre-existing risk and evidence-based approaches to biosafety thereby further promoting safety culture, 3) clinical laboratories by presenting up-to-date information regarding the level of conformity of medical technologists to biosafety measures, 4) general public by ensuring their safety through strict adherence of medical technologists to biosafety practices, and 5) future researchers by giving an overview of the current status of biosafety measures in selected public and private clinical laboratories located in Bataan, Batangas, Bulacan, and Camarines Sur.

II. RELATED LITERATURE ON BIOSAFETY KNOWLEDGE, ATTITUDES AND PRACTICES

The Centers for Disease Control and Prevention (2009) defined Biological Safety or Biosafety as the discipline that addresses safe handling and containment of infectious microorganisms and hazardous biological materials.^[5] The government agency also cited that parallel development is required between the knowledge and skill of laboratory professionals, and biosafety practices which consist of containment principles, facility design, practices and procedures that reduce occupational infection. Apondi *et al.* (2017) stated that the core biosafety principles provided in the World Health Organization biosafety manual must be observed uniformly across all laboratories.^[6]

However, certain issues on compliance to standard precaution have been cited in several studies. Medical practitioners opted to choose whether they should or should not follow the standard precautions.^[7] Khokhar (2013) stated that non-compliance to standard precautions is caused by three factors such as knowledge, practice, and attitude towards standard precautions.^[8] Furthermore, issues pertaining to occupational biohazards in developing countries are not given adequate attention by both employees and employers.^[9] The inadequacy of biosafety training and lack of awareness regarding proper waste disposal and biosafety practices among healthcare practitioners have showed gross deficiencies in knowledge, attitude, and practice of biosafety among healthcare practitioners.^{[10][11]}

The results of the study conducted by Al-Abhar *et al.* (2017) showed how biosafety is compromised and neglected in low-resource countries like Yemen. The low percentage of laboratory staff who acquired biosafety manual and training indicated their weak commitment to biosafety policies.^[12] Ahmad *et al.* (2018) showed that laboratory personnel in varying areas of Karachi, Pakistan were not aware of good and hygienic laboratory practices.^[13] In another study, health care workers in sub-Saharan Africa needed to address the unavailability of proper biosafety policies and practices by giving the issue of biosafety utmost priority in laboratory practice.^[14] The results of the study revealed that on the average, private laboratories better complied with good laboratory practices than public laboratories.

III. METHODOLOGY

A. Study Design

This study utilized the Descriptive-Comparative research design. The paper was descriptive in nature as it utilized descriptions derived from the sample means in determining the levels of knowledge, attitudes, and practices on biosafety, and the level of application of COVID-19 biosafety protocols. Moreover, this paper was comparative as it intended to determine if there is a significant difference among Filipino registered medical technologists working in either public or private clinical laboratories located in the provinces of Bataan, Batangas, Bulacan, and Camarines Sur based on their levels of knowledge on standard biosafety practices, attitudes towards following biosafety practices inside clinical laboratories, practices of biosafety in their daily operations, and application of COVID-19 biosafety protocols.

B. Study Sample

The study involved two hundred forty-four (244) Filipino registered medical technologists who were currently working in either primary, secondary, or tertiary public or private clinical laboratories in the provinces of Bataan, Batangas, Bulacan, and Camarines Sur. Snowball sampling was used in the selection of the respondents wherein each respondent was requested by the researchers to provide referrals in recruiting potential subjects for the study.^[15] For the initial respondents of the study, 5 participants came from Batangas, 3 participants from Bulacan, 1 participant from Bataan, and another 1 participant from Camarines Sur. In total, these 10 initial respondents were asked

to refer potential subjects who fit the inclusion criteria of the study. This process continued until the researchers were able to obtain 244 respondents.

C. Data Instrumentation

The data instrumentation utilized in the study is in the form of a questionnaire formulated by the researchers and validated by conducting a pilot study. The questions and statements were designed to be in accordance with the standard biosafety practices stated in the review of related literature and feedbacks from the Faculty of Pharmacy Research Ethics Committee of the University of Santo Tomas. The questionnaire was divided into five parts.

The first part was related to the socio-demographic profile of the participants such as name, age, gender, location of their clinical laboratories, years of clinical laboratory experience, role inside the laboratory, classification of their clinical laboratories or workplace according to ownership and service capability, and any biosafety training undergone by the participants. The second part of the questionnaire, named as the Knowledge Evaluation Questionnaire (KEQ), included questions that tested the level of knowledge of the participants regarding terminologies, equipment, and methods related to standard biosafety practices. It consisted of 15 questions in multiple-choice format. The third part of the questionnaire, named as the Attitude Likert Scale Questionnaire (ALSQ), assessed the attitudes of the participants towards following the standard biosafety practices. This part consisted of 4 statements. The fourth part of the questionnaire, named as the Practice Likert Scale Questionnaire (PLSQ), consisted of 15 statements regarding the level of biosafety practice among the participants. The statements were constructed using a first-person point of view. Lastly, the fifth part of the questionnaire, named as the COVID-19 Biosafety Likert Scale Questionnaire (CBLSQ), included 9 statements that assessed how the knowledge, attitudes, and practices on biosafety of the participants were applied in the aspect of 2019 Coronavirus disease prevention.

D. Procedure for Data Collection and Analysis

The data collection was conducted from February 16 until March 22, 2021. Prior to the actual data gathering, a pilot study was conducted by administering the questionnaire to 30 Filipino registered medical technologists selected through

snowball sampling who are currently working in private or public clinical laboratories located in provinces outside Bataan, Batangas, Bulacan, and Camarines Sur. The chosen participants would no longer be part of the actual study.

The responses obtained from the pilot testing were then submitted to the assigned statistician from the University of Santo Tomas Research Center for Social Sciences and Education for analysis and validation of the research questionnaire. For the Knowledge Evaluation Questionnaire (KEQ), the difficulty indices per question were determined. Items 3, 4, 7 and 8 which had difficulty indices of 0.63, 0.60, 0.33 and 0.73, respectively, were retained. The questions that scored greater than 0.75 were revised and validated by the Thesis adviser. For the Likert scale questionnaires, the reliability of the statements was determined by computing for the Cronbach's alpha per group or factor. For the Attitude Likert Scale Questionnaire (ALSQ), the Cronbach's alpha value was 0.733, which was interpreted as good. For Practice Likert Scale Questionnaire (PLSQ), the Cronbach's alpha value was 0.830, which was interpreted as very good. Likewise, the COVID-19 Biosafety Likert Scale Questionnaire (CBLSQ) had an interpretation of very good with a Cronbach's alpha value of 0.877.

After the validation of the research tool, the researchers surveyed two hundred forty-four (244) Filipino registered medical technologists who are currently working in either primary, secondary, or tertiary public or private clinical laboratories in Bataan, Batangas, Bulacan, and Camarines Sur. Snowball sampling was used in the selection of the participants.

During the administration of the survey questionnaire through an online application called Google Forms, the consent of the participants was obtained by marking the designated box that will indicate that they had read and fully understood the consent form and that they are willing to continue their participation in the study. Moreover, they were given the right to withdraw from the study at any point if they wished to do so.

To ensure the validity of the answers, a check box at the end of the questionnaire must be ticked by the research participants to signify that they answered the survey questionnaire independently, with complete honesty and to the best of their ability. Additionally, the researchers requested the participants to input their license number for validation and identification purposes. Once they pressed the Submit button, their responses

were automatically saved and submitted. They were sent a summary of their responses to better guarantee transparency in all communications related to the study.

To determine the Cronbach's alpha values, difficulty indices, mean, frequencies, percentages, variance, standard deviation, t values, and p values for data analysis, the researchers utilized the IBM SPSS Statistics version 22. This process was validated by the assigned statistician from the University of Santo Tomas Research Center for Social Sciences and Education.

In comparing the difference in the levels of knowledge, attitudes, and practices on biosafety among the Filipino registered medical technologists working in either public or private clinical laboratories located in the selected provinces of the study, the T-test with a confidence interval set to 95% was utilized. A p-value of less than 0.05 (p-value <0.05) was considered statistically significant.

Following the computation of the means, the levels of knowledge, attitudes and practices on biosafety were interpreted according to the tables for interpretation presented as follows. These tables of interpretation were developed by the researchers with the approval of a statistician from the University of Santo Tomas Research Center for Social Sciences and Education.

Table.1. Knowledge Evaluation Questionnaire (KEQ) Interpretation

Score	Interpretation
11 – 15 points	Proficient Biosafety Knowledge
6 – 10 points	Good Biosafety Knowledge
0 – 5 points	Poor Biosafety Knowledge

As shown in Table 1, scores ranging from 11 to 15 points are interpreted as proficient biosafety knowledge, while scores ranging from 6 to 10 points are considered good biosafety knowledge. A poor biosafety knowledge is the interpretation for scores 5 and below.

Table.2. Attitude Likert Scale Questionnaire (ALSQ) Interpretation

Scale	Interpretation
3.25 – 4.00	Commendable Attitude towards Biosafety

2.50 – 3.24	Good Attitude towards Biosafety
1.75 – 2.49	Fair Attitude towards Biosafety
1.00 – 1.74	Poor Attitude towards Biosafety

As shown in Table 2, scores ranging from 3.25 to 4.00 are considered commendable attitude towards biosafety. Scores ranging from 2.50 to 3.24 are interpreted as good attitude towards biosafety. A fair attitude towards biosafety is the interpretation for scores ranging from 1.75 to 2.49. A poor attitude towards biosafety corresponds to scores 1.74 and below.

Table.3. Practice Likert Scale Questionnaire (PLSQ) Interpretation

Scale	Interpretation
3.25 – 4.00	Commendable Practice of Biosafety
2.50 – 3.24	Good Practice of Biosafety
1.75 – 2.49	Fair Practice of Biosafety
1.00 – 1.74	Poor Practice of Biosafety

As shown in Table 3, a commendable practice of biosafety corresponds to scores ranging from 3.25 to 4.00. Good practice of biosafety is the interpretation for scores ranging from 2.50 to 3.24. For fair practice of biosafety, the corresponding scores range from 1.75 to 2.49. A poor practice of biosafety corresponds to a score of 1.74 or below.

Table.4. COVID-19 Biosafety Likert Scale Questionnaire (CBLSQ) Interpretation

Scale	Interpretation
3.25 – 4.00	Commendable Application of COVID-19 Biosafety
2.50 – 3.24	Good Application of COVID-19 Biosafety
1.75 – 2.49	Fair Application of COVID-19 Biosafety
1.00 – 1.74	Poor Application of COVID-19 Biosafety

As shown in Table 4, a commendable application of biosafety corresponds to scores ranging from 3.25 to 4.00. A good application of biosafety is the interpretation for scores ranging from 2.50 to 3.24. For a fair application of biosafety, the

corresponding scores range from 1.75 to 2.49. Poor application of biosafety corresponds to scores of 1.74 and below.

E. Ethical Considerations

This research study has been approved by the University of Santo Tomas - Faculty of Pharmacy Research Ethics Committee. As participation in the study only required answering the prepared and validated survey questionnaire purposely designed for this study, it was anticipated that the study posed minimal risks on the respondents. There was no use of offensive, discriminatory, or other unacceptable language in the formulation of the survey questionnaire.

An informed consent sheet was placed before the actual survey questionnaire. The participants were informed that their participation had no bearing on their job or on any work-related evaluations or reports. These respondents were given the rights to withdraw from the study at any point if they wished to do so without any penalty. Furthermore, they were given an option to provide their license number for validation and identification purposes.

The privacy and confidentiality of the respondents and the information they provided during the study were protected and given utmost importance in compliance with Republic Act No. 10173, also known as the Data Privacy Act of 2012. Although the names of the respondents were asked for identification and verification purposes, these were not revealed in the published paper. Access to the responses of the survey were only given to the five (5) researchers of the study and their thesis adviser. The data forwarded to the statistician from the University of Santo Tomas Research Center for Social Sciences and Education for analysis and interpretation were already modified wherein information that may reveal the identity of the respondents had been removed to prevent any breach of privacy and confidentiality.

The data collected from the respondents will be stored for a maximum of one (1) year. After this period, all the gathered information, including the backup data would be permanently deleted and no longer be used for future studies. The respondents received a summary of the results that better guaranteed honesty and transparency in all communications related to the study. The highest level of objectivity was maintained in all the discussions and analyses made throughout the research. The release of any type of misleading information

and representation of primary data findings in a biased manner were not done in the study.

IV. RESULTS AND DISCUSSION

Table.5. presents the frequency and percentages of the respondents' socio-demographic profile. In terms of location of their clinical laboratories, among the 244 Filipino registered medical technologists, 29.92% (n = 73) were from Batangas, 22.13% (n = 54) were from Bataan, 22.13% (n = 54) were from Bulacan and 25.82% (n = 63) were from Camarines Sur. Therefore, the province of Batangas had the highest number of respondents.

In terms of classification of clinical laboratory according to ownership, among the 244 Filipino registered medical technologists, 61.48% (n = 150) were working in private clinical laboratories, whereas 38.52% (n = 94) were working in public clinical laboratories. Therefore, majority of the respondents were serving in private clinical laboratories owned and operated by any individual or organization.

In terms of biosafety training, among the 244 registered medical technologists, 23.77% (n = 58) underwent biosafety training, while the remaining 76.23% (n = 186) have not attended any biosafety training. Therefore, majority of the respondents did not have prior experience of participating in any biosafety training.

Table.6. displays the frequency and percentages for the levels of knowledge, attitudes, practices, and COVID-19 biosafety application among Filipino RMTs by classification of clinical laboratory according to ownership.

In terms of level of knowledge on standard biosafety, among the 94 Filipino registered medical technologists working in public clinical laboratories, 65.96% (n = 62) had exhibited good biosafety knowledge, 30.85% (n = 29) had proficient biosafety knowledge and 3.19% (n = 3) had demonstrated poor biosafety knowledge. Furthermore, among the 150 Filipino registered medical technologists working in private clinical laboratories, 68.67% (n = 103) had good biosafety knowledge, 28.00% (n = 42) had proficient biosafety knowledge, and 3.33% (n = 5) of them had shown poor biosafety knowledge. Therefore, majority of the Filipino registered medical technologists working in the research locale had displayed good biosafety knowledge.

In terms of level of attitude towards following biosafety practices, among the 94 Filipino registered medical technologists working in public clinical laboratories, 90.43% (n = 85) had manifested commendable attitude towards biosafety, 8.51% (n = 8) had good attitude toward biosafety and 1.06% (n = 1) had demonstrated poor attitude towards biosafety. On the contrary, among the 150 Filipino registered medical technologists working in private clinical laboratories, 96.00% (n = 144) had commendable attitude towards biosafety, 2.67% (n = 4) had good attitude towards biosafety, and 1.33% (n = 2) of them had shown poor attitude towards biosafety. Therefore, majority of the Filipino registered medical technologists working in clinical laboratories located in the selected provinces had displayed commendable attitude towards biosafety.

In terms of level of biosafety practice, 97.87% (n = 92) Filipino registered medical technologists working in public clinical laboratories exhibited commendable practice of biosafety and the remaining 2.13% (n = 2) showed good practice of biosafety. Moreover, during the analysis of the data gathered from 150 respondents working in private clinical laboratories, 94.00% (n = 141) demonstrated commendable practice of biosafety while the remaining 6.00% (n = 9) were found to have good practice of biosafety. Therefore, majority of the Filipino registered medical technologists working in the research locale possessed commendable practice of biosafety.

In terms of level of application of COVID-19 biosafety protocols 97.87% (n = 92) of the Filipino registered medical technologists working in public clinical laboratories were found to have commendable application of COVID-19 biosafety protocols. The remaining 2.13% (n = 2) of the respondents from public clinical laboratories had good application of COVID-19 biosafety protocols. Similarly, among the Filipino registered medical technologists working in private clinical laboratories, 98.67% (n = 148) had commendable application of COVID-19 biosafety protocols while the remaining 1.33% (n = 2) of the respondents had good application of COVID-19 biosafety protocols. Therefore, majority of the Filipino registered medical technologists working in either public or private clinical laboratories located in the selected provinces of the study had commendable application of COVID-19 biosafety protocols.

Table.7. shows the results in comparing Filipino registered medical technologists working in either public or private

clinical laboratories located in the research locale, using T-test with a confidence interval of 95%. A p-value of less than 0.05 ($p\text{-value} < 0.05$) was considered statistically significant. As indicated in the Table 7, there is no significant difference on the level of knowledge ($t = -0.920$, $p = 0.359$), attitude

($t = -0.573$, $p = 0.567$), practice ($t = -0.196$, $p = 0.845$) and COVID-19 Biosafety application ($t = -0.212$, $p = 0.832$) among Filipino registered medical technologists working in either public or private clinical laboratories.

Table.5. Frequency and Percentages for the Socio-Demographic Profile of the Study Sample

Variable	Frequency (n=244)	Percentage (%)
Location of the Clinical Laboratory		
Bataan	54	22.13
Batangas	73	29.92
Bulacan	54	22.13
Camarines Sur	63	25.82
Classification of Clinical Laboratory according to Ownership		
Private	150	61.48
Public	94	38.52
Underwent a Biosafety Training		
Yes	58	23.77
No	186	76.23

Table.6. Frequency and Percentages for the Levels of Knowledge, Attitudes, Practices and COVID-19 Biosafety Application among Filipino Registered Medical Technologists, by Classification of Clinical Laboratory according to Ownership

Variable	Level	Public		Private	
		Frequency (N= 94)	Percentage (%)	Frequency (N = 150)	Percentage (%)
Knowledge	Proficient Biosafety Knowledge	29	30.85	42	28.00
	Good Biosafety Knowledge	62	65.96	103	68.67
	Poor Biosafety Knowledge	3	3.19	5	3.33
Attitude	Commendable Attitude towards Biosafety	85	90.43	144	96.00
	Good Attitude towards Biosafety	8	8.51	4	2.67
	Fair Attitude towards Biosafety	0	0.00	0	0.00
	Poor Attitude towards Biosafety	1	1.06	2	1.33
Practice	Commendable Practice of Biosafety	92	97.87	141	94.00
	Good Practice of Biosafety	2	2.13	9	6.00
	Fair Practice of Biosafety	0	0.00	0	0.00
	Poor Practice of Biosafety	0	0.00	0	0.00
COVID-19 Biosafety	Commendable Application of COVID-19 Biosafety	92	97.87	148	98.67
	Good Application of COVID-19 Biosafety	2	2.13	2	1.33
	Fair Application of COVID-19 Biosafety	0	0.00	0	0.00
	Poor Application of COVID-19 Biosafety	0	0.00	0	0.00

Table.7. T-test on the Levels of Knowledge, Attitudes, Practices and COVID-19 Biosafety Application among Filipino Registered Medical Technologists

Variable	Public		Private		<i>t value</i>	<i>p value</i>
	Mean	Standard deviation	Mean	Standard deviation		
Knowledge	6.62	2.059	6.86	1.976	-0.920	0.359
Attitude	3.71	0.464	3.75	0.403	-0.573	0.567
Practice	3.75	0.258	3.76	0.274	-0.196	0.845
Covid-19 Biosafety	3.92	0.176	3.92	0.171	-0.212	0.832

A. Assessment on the Levels of Knowledge, Attitudes, Practices and COVID-19 Biosafety Application

The good biosafety knowledge displayed by the Filipino registered medical technologists working in the research locale implies that they are well-aware of the standard biosafety practices followed across clinical laboratories. This result agrees with the American Biological Safety Association (2017) which stated that healthcare professionals should possess knowledge on biosafety inside the laboratory, epidemiological principles, risk assessment and management, and disease prevention and control.^[16]

Meanwhile, the commendable attitude towards biosafety demonstrated by the Filipino registered medical technologists indicates their positive attitude towards following biosafety practices. Such result is in congruence with the study of Wader, Kumar & Mutalik (2013) which explained that good attitude is due to professionals' knowledge on biosafety precautions and awareness about the implication of their actions.^[17]

Similarly, the commendable practice of biosafety among Filipino registered medical technologists denotes that they strictly adhere to the Administrative Order promulgated by the Department of Health (2007) entitled, "Revised Rules and Regulations Governing the Licensure and Regulation of Clinical Laboratories in the Philippines" which ensures that clinical laboratories in the Philippines comply with the given standards in order to be allowed license to operate.^[18] The standards relate to those published in the laboratory biosafety manual of the World Health Organization (WHO), which serves as the global criterion for proper biosafety practices.

Likewise, the Filipino registered medical technologists included in the study also displayed commendable application of COVID-19 Biosafety protocols. This implies that Filipino RMTs abide by the strict implementation of the biosafety protocols in relation to COVID-19 testing. This result agrees with the statement of the Research Institute for Tropical Medicine (2020) which emphasized the importance of adherence to the standard biosafety practices and compliance to the national guidelines as part of laboratory biorisk management in performing SARS-CoV-2 diagnostic tests.^[19]

B. Comparison on the Levels of Knowledge, Attitudes, Practices and COVID-19 Biosafety Application

The T-test results revealed that there is no significant difference on the level of knowledge among Filipino registered medical technologists in either public or private clinical laboratories within the research locale. This means that the type of ownership of clinical laboratories does not have a significant influence on the level of knowledge among Filipino registered medical technologists working in the research locale. The result is expected as stipulated in the fourth edition of the World Health Organization biosafety manual that risk control measures should serve as minimum requirements for all clinical laboratories regardless of biosafety levels.^[4] The standard precautions should always be observed and adopted. These core biosafety principles should be uniform across all clinical laboratories regardless of ownership. However, minor modifications may vary in each laboratory according to its setting and function.^[9]

Consequently, the results of the T-test revealed that Filipino registered medical technologists working in either public or

private clinical laboratories within the research locale do not have a significant difference in showing a positive attitude towards strict compliance to biosafety and standard operating procedures mandated by their respective laboratories. This result agrees with the study conducted by Abhayaratne *et al.* (2020) in which majority of the respondents also showed positive attitude towards biosafety.^[10] Adebimpe (2016) explained that the positive attitude towards compliance to biosafety is significantly associated with practice of safety precautions ($p = 0.007$).^[20]

Likewise, there is no significant difference in the level of biosafety practice among Filipino registered medical technologists working in either public or private clinical laboratories within the research locale. This means that regardless of the type of ownership of clinical laboratories, Filipino registered medical technologists conform to practicing the corresponding biosafety protocols implemented in their respective workplace. The result is consistent with the study of Barnie *et al.* (2019) who concluded that majority of their respondents performed good laboratory practices and dutifully complied with the standard operating procedures of the laboratory. Commendable biosafety protocols such as not eating nor drinking inside the clinical laboratory, not practicing mouth pipetting, washing of hands prior to leaving the working area, and the removal of personal protective equipment before leaving the laboratory to avoid contamination were reported to be highly observed.^[23]

Lastly, Filipino registered medical technologists working in either public or private clinical laboratories within the research locale do not have a significant difference in showing a commendable application of COVID-19 Biosafety protocols mandated in their laboratories. The results are in congruence with the study conducted by Yuan *et al.* (2020) who performed the first comprehensive evaluation of biosafety in all 89 clinical laboratories located in the Sichuan Province of China. The results of the study showed an overall median compliance rate of 94.6% for 39 criteria. The most satisfactorily met categories were personnel training and protection, followed by laboratory environmental disinfection, emergency plans, and accident handling.^[24]

V. CONCLUSION

Studying the levels of knowledge, attitudes, and practices on biosafety among Filipino registered medical technologists

provides a good reflection of the response of these laboratory professionals and clinical laboratories towards the ongoing COVID-19 pandemic. The study revealed that Filipino registered medical technologists in Bataan, Batangas, Bulacan and Camarines Sur are aware of the recent biosafety guidelines set by the World Health Organization and have a positive attitude towards compliance and practice of biosafety protocols as well as safety precautions. Moreover, they were able to establish a safety culture in their respective laboratories. The study further indicated that there is no significant difference between public and private clinical laboratories in the research locale. These results help ensure the safety of laboratory professionals and the general public seeking the services of Filipino medical technologists.

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