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Perception of Medical Technologists on the Diagnostic Assays Utilized for Chikungunya in Clinical Laboratories around Metro Manila and Rizal, Philippines

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Abstract:- Chikungunya infection is commonly found in tropical countries such as the Philippines. The study aims to assess the perception of registered medical technologists (RMTs) on the sensitivity, specificity, and turnaround time of the diagnostic assays for chikungunya in clinical laboratories around Metro Manila and Rizal. A descriptive survey was conducted among 51 RMTs wherein only 45 had previous knowledge and/or experience with the diagnostic assays utilized for chikungunya. The perception of the RMTs was assessed using a survey that consists of a 5-point Likert scale on their perceptions regarding the sensitivity, specificity, and turnaround time of the different diagnostic assays and a 7-point Likert scale on their perception on its appropriateness. A total of 34 respondents were from Metro Manila and 11 were from Rizal. Overall, the most renowned diagnostic assays were the Rapid Immunochromatographic Diagnostic Test) and the Enzyme-linked Immunosorbent Assay (ELISA)). The correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its appropriateness was only statistically significant in the Rapid Immunochromatographic Diagnostic Test and the ELISA. The Rapid Immunochromatographic Diagnostic Tests revealed a statistically significant low positive correlation between its sensitivity and appropriateness and between its specificity and appropriateness. Whereas the results for ELISA only revealed a statistically significant low negative correlation between its turnaround time and appropriateness. Future researchers should increase the sample size and extend the inclusion criteria to a wider scope of location in the Philippines for a better assessment of the differences in diagnostic assays. Additionally, future researchers may conduct the study with an extended time frame for possible interviews with participants.

Keywords:- *Chikungunya; Clinical Laboratories; Diagnostic Assays; Medical Technologists.*

I. INTRODUCTION

Chikungunya virus (CHIKV) is a mosquito-borne pathogen closely related to the Dengue virus (DENV) that is mainly emerging and re-emerging in tropical and subtropical countries [25][27][28][29]. It is a re-emerging disease in the Philippines and outbreaks have since begun increasing in number wherein the first reported nationwide outbreak was dated back in 2011 as reported by the Department of Health (DOH) [27][29]. Based on the chikungunya disease surveillance reports from 2016 to 2018 by the Department of Health[8], CHIKV continues to be present nationwide in the Philippines. The recent available chikungunya disease surveillance report, covering January 1 to March 3 of the year 2018, reported a total of 282 cases. With these, multiple challenges are still present in obtaining a reliable result through the different serological diagnostic tests for chikungunya virus. One of these includes its close relation to other arboviruses where CHIKV infection is often mistaken as a Dengue virus (DENV) or Zika virus (ZIKV). The overlapping symptoms and geographic distribution among the three also pose a challenge in acquiring a reliable diagnosis of chikungunya virus [25]. The availability of appropriate and accurate diagnostic tests for chikungunya is needed to be able to detect cases of infection and to provide immediate responses to control emerging outbreaks [20].

The aim of this study is to assess the perception of medical technologists on the sensitivity, specificity, and turnaround time of the diagnostic assays for chikungunya in clinical laboratories. Additionally, this study specifically aims to identify which of the factors (specificity, sensitivity, turnaround time) is considered as most important by medical technologists in the determination of the suitable diagnostic assay for the diagnosis of chikungunya; to investigate the sensitivity, specificity, and turnaround time of the different diagnostic assays; to evaluate the level of appropriateness of the diagnostic assay; and to correlate the significance between the factors considered (specificity, sensitivity, turnaround time) in a diagnostic assay and its level of

appropriateness on the diagnosis of chikungunya based on the perception of the medical technologists.

II. METHODOLOGY

A. Research Design

In this research, a quantitative correlational research design using a descriptive survey from a standardized questionnaire was used to measure the participants' feedback regarding the diagnostic assays utilized in their respective clinical laboratories. Moreover, the use of a descriptive survey method was performed in order to assess the perception of medical technologists on the diagnostic assays for chikungunya in the Philippine setting.

B. Instrumentation

A survey questionnaire was utilized to gather the necessary information for data analysis in order to test the hypothesis. The questions included in the survey regarding the information of the respondent and the laboratory was adapted from the study conducted by Bhattacharya et al.[3] while another study by Saringe et al.[26] for the diagnostic practices regarding chikungunya among healthcare workers.

C. Sampling

The researchers utilized a non-probability purposive quota sampling technique in which they have selected respondents based on a non-random criterion in order to gather sufficient data. A purposive quota sampling was employed wherein the researchers will have a sample size of 51 respondents that were evaluated through the survey questionnaire. In order to control and develop an initial understanding of the research population, the research study has excluded respondents who do not adhere to the established criteria. The criteria for the respondents required them to be a registered medical technologist working in a clinical laboratory in Metro Manila and Rizal that have previous knowledge and/or experience with the different diagnostic assays for chikungunya virus.

Due to the Coronavirus (COVID-19) pandemic, social distancing protocols were administered which prohibited face-to-face surveying of the research subjects. In compensation for the recruitment process, the researchers have posted on social media (Facebook) and have contacted different registered medical technologists that satisfied the inclusion criteria in which they were informed of the research. The Google Forms link to the survey questionnaire was also included in the invitation to participate in the study. The informed consent form is included in the Google Forms wherein the participant may opt to participate or withdraw from the study. This study will benefit the medical field by providing information regarding the perception of registered medical technologists on the diagnostic assays used for chikungunya in terms of its sensitivity, specificity, turnaround time, and its appropriateness. The information gathered will be beneficial for future researchers to see how important it is to explore the different perspectives of healthcare professionals and the limitations of the various diagnostic assays. explore the different perspectives of healthcare professionals and the limitations of the various diagnostic assays.

D. Data Gathering Procedure

The researchers have come up with a survey questionnaire to be relayed to the medical technologists in the clinical laboratories who have handled chikungunya diagnostic assays. The questionnaire was distributed through Google Forms for convenient data gathering and storage. The data gathering procedure was done in a span of two months. The researchers have distributed the informed consent form together with the survey questionnaire to the registered medical technologists who have had previous knowledge and/or experience with the diagnostic assays for chikungunya. The survey questionnaire was designed to gather insights and data from the participants regarding their perception on the diagnostic assays for chikungunya that they have utilized. The survey will be deployed through email and social media (Facebook). The respondents were assured of their anonymity and confidentiality by the researchers. The data gathered were compiled in a Google drive that only the researchers and their adviser have access to. During the checking of data gathered, the researchers have excluded the participants who did not satisfy the inclusion criteria prior to data analysis. Moreover, only the responses of those who meet the inclusion criteria were included in the results of the study. The information was then analyzed and checked by the researchers along with a statistician in the identification of the correlation between the factors considered by the medical technologist in relation to the level of appropriateness of the diagnostic assay. The statistician was only given a spreadsheet file containing the data to be computed; the actual names and personal information of the participants were not included. Finally, the information gathered was disposed of by the end of May 2021 through erasing all the answers of the respondents who submitted in the Google forms.

III. STATISTICAL ANALYSIS

The researchers made use of the R studio computer program to calculate the Spearman rank-order correlation coefficient (Spearman's correlation) for the inferential statistics in the data analysis. The Spearman rank-order correlation coefficient was used for a non-parametric measurement of the strength and direction of the association between two variables measured at a minimum on an ordinary scale. Either ordinal variables or those with continuous data that have failed the assumptions necessary for conducting Pearson's product-moment correlation have utilized this test [17]. The independent variable measured in the study included the factors considered in a diagnostic assay (sensitivity, specificity, turnaround time), while the dependent variable was the assay's level of appropriateness in the diagnosis of chikungunya based on the perception of the medical technologist.

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The correlations of the sensitivity, specificity, and turnaround time on the appropriateness are computed for each of the diagnostic assays. The correlation coefficient ranges from [-1,1]. Values that are closer -1 or 1 indicates that the association of the two variables is said to be strong. However, values that are close to 0 indicates that the association of the two variables is weak or may also be considered to have no association. Additionally, a negative correlation coefficient indicates an inverse relationship of the two variables where if one variable increases, the other variable tends to decrease and vice versa. A positive correlation coefficient indicates that as one variable increases, the other tends to also increase, or as one variable decreases, the other variables tend to decrease as well [19].

The significance of the correlation coefficients were tested at 0.05 level of significance. This indicated that the correlation coefficients with p-values that are less than or equal to 0.05 are said to be statistically significant at 0.05 level of significance. Otherwise, p-values that are greater than 0.05 have no sufficient evidence to conclude that there is significant relationship or association between the two variables of interest at 0.05 level of significance.

The researchers have also utilized the MAXQDA Qualitative Data Analysis for the responses gathered in the open-ended question included in the survey questionnaire. The words with a high frequency among the answers of the respondents appear to be more prominent in the word cloud generated which allowed for the analysis of the recurring theme among the responses. Lastly, the data obtained from this study aided in the identification of the appropriateness of the diagnostic assays for chikungunya detection as perceived by the medical technologists in clinical laboratories in Metro Manila and Rizal, Philippines. Data gathered from this will provide insight to possible improvement in healthcare focusing on the diagnostic assays for chikungunya.

IV. RESULTS

A. Demographics

Tables 1 to 4 shows the demographic information regarding the participants and their respective clinical laboratory.

TABLE I. Location of Laboratories of Respondents

Location	Frequency	Percentage
Metro Manila	34	75.56%
Rizal	11	24.44%
Total	**45**	**100.00%**

Table 1 shows the city or town of the respondents. Most of the respondents are residing in Metro Manila (75.56%), while the rest of the respondents are from Rizal (24.44%).

TABLE II. Chikungunya Virus Testing included in NEQAS

Chikungunya test in NEQAS	Frequency	Percentage
No	37	82.22%
Yes	8	17.78%
Total	**45**	**100.00%**

The respondents were asked if the Chikungunya virus (CHIKV) testing is part of their routine NEQAS. The majority of the respondents have CHIKV testing as part of their routine National External Quality Assurance Scheme (NEQAS) n=37 (82.22%), while eight (8) respondents indicated otherwise (17.78%).

TABLE III. Types of Hospital Served by the Respondents

Type of Hospital/Laboratory	Frequency	Percentage
Medical College	0	0.00%
Government Hospital	13	28.89%
Private Hospital	16	35.56%
Reference Laboratory	0	0.00%
Free-standing Laboratory	11	24.44%
Others[a]	5	11.11%
Total	**45**	**100.00%**

[a.] Rural Health Unit; Swabbing Facility; City Health Office

Table 3 displays the type of hospital that the respondents serve. The majority of laboratories of the respondents serve private hospitals n =16 (35.56%). Thirteen (13) laboratories of the respondents serve government hospitals (28.89%) and eleven (11) are from free-standing laboratories (24.44%). The rest of the respondents are either from rural health units, swabbing facilities, and city health offices (11.11%).

TABLE IV. Persons Managing Chikungunya Testing

Persons Managing Chikungunya Testing	Frequency		Percentage	
	Yes	*No*	*Yes*	*No*
Supervisor	8	37	17.78%	82.22%
Section Head	12	33	26.67%	73.33%
Senior Medical Technologist	30	15	66.67%	33.33%
Junior Medical Technologist	7	38	15.56%	84.44%
Others[a]	7	38	15.56%	84.44%

[a.] No Chikungunya testing in our lab; No testing available; Trained med tech; the only medical technologist; Not applicable

Table 4 shows who manages the chikungunya testing in the laboratories of the respondents. The majority of Chikungunya testing is done by the senior medical technologists of the respondents (66.67%). Additionally, testing is managed by the section head of the respondents (26.67%), laboratory supervisors (17.78%), and junior medical technologists (15.56%). The rest is from a trained medical technologist, their only medical technologist, or there is no available chikungunya testing in their respective laboratory (15.56%).

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Table 5 and 6 shows the responses collected regarding the diagnostic practices regarding chikungunya among healthcare workers wherein the questions were adapted from an open access journal article in BMC Research Notes by Saringe et al.[26] entitled "Healthcare workers knowledge and diagnostic practices: A need for dengue and chikungunya training in Moshi Municipality, Kilimanjaro Tanzania."

TABLE V. Availability of Diagnostic Tools for Chikungunya Infection

Availability of Chikungunya Diagnostic Tools	Frequency	Percentage
No	9	20.00%
Yes	36	80.00%
Total	**45**	**100.00%**

When the respondents were asked if there are diagnostic tools for the laboratory diagnosis of chikungunya infection, most of the respondents (80.00%) said yes while the remaining respondents (20.00%) indicated that their laboratories do not have diagnostics for the diagnosis of the chikungunya infection.

TABLE VI. Perception of Respondents whether Absences in Diagnoses Lead to Difficulties in Managing Infections

Absences in Diagnoses Lead to Difficulties	Frequency	Percentage
No	2	4.44%
Yes	43	95.56%
Total	**45**	**100.00%**

When the respondents were asked if there are diagnostic tools for the laboratory diagnosis of chikungunya infection, most of the respondents (80.00%) said yes while the remaining respondents (20.00%) indicated that their laboratories do not have diagnostics for the diagnosis of the chikungunya infection.

TABLE VII. Factors Considered Most Important as Ranked by the Respondents

Factors	Frequency			Percentage		
	1	*2*	*3*	*1*	*2*	*3*
Sensitivity	23	18	4	51.11%	40.00%	8.89%
Specificity	21	22	2	46.67%	48.89%	4.44%
Turnaround Time	1	5	39	2.22%	11.11%	86.67%

The table above shows the ranking of importance of the factors in the determination of a suitable diagnostic assay for the diagnosis of chikungunya. Majority of the respondents (51.11%) said that the most important factor is sensitivity. This is followed by twenty-one (21) respondents (46.67%) who said that the specificity is considered as the most important factor. Lastly, only a few of the respondents (2.22%) said that the turnaround time is the most important factor. It is also notable to mention that the majority of the respondents (86.67%) considered that the least importance is the turnaround time in determination for a suitable diagnostic assay for the diagnosis of Chikungunya.

TABLE VIII. Other Factors Considered by the Respondents

Other Factors Considered	Frequency	Percentage
Not Applicable	43	95.56%
Other factors[a]	2	4.44%
Total	**45**	**100.00%**

[a.] Cost; Suitability of the test to the locale

The respondents were asked for other factors to consider when performing diagnostic assays for Chikungunya aside from sensitivity, specificity, and turnaround time. Majority of the respondents (95.56%) said that there are no other factors to consider when performing diagnostic assays for Chikungunya. Two (2) respondents (4.44%) indicated that cost and suitability of the test to the locale are other factors to consider.

TABLE IX. Diagnostic Assays that the Respondents Have Used Before or Have Previous Knowledge on for the Diagnosis of Chikungunya

Diagnostic Assay	Frequency		Percentage	
	Yes	*No*	*Yes*	*No*
Rapid Immunochromatographic Diagnostic Tests	25	20	55.56%	44.44%
ELISA	33	12	73.33%	26.67%
i-ELISA	7	38	15.56%	84.44%
MAC-ELISA	8	37	17.78%	82.22%
EB-ELISA	2	43	4.44%	95.56%
IIFT	5	40	11.11%	88.89%
MNA	0	45	0.00%	100.00%
PRNT	0	45	0.00%	100.00%
PBNA	0	45	0.00%	100.00%
PLVBNA	0	45	0.00%	100.00%
PCR	12	33	26.67%	73.33%
Real Time PCR	8	37	17.78%	82.22%
End Point PCR	3	42	6.67%	93.33%
Real Time Reverse Transcription PCR	6	39	13.33%	86.67%
SYBR Green Based Real-Time Multiplex RT-PCR Assay	0	45	0.00%	100.00%
RT-RPA	0	45	0.00%	100.00%
LAMP	2	43	4.44%	95.56%
RT-LAMP	2	43	4.44%	95.56%

The respondents were asked for other factors to consider when performing diagnostic assays for Chikungunya aside from sensitivity, specificity, and turnaround time. Majority of the respondents (95.56%) said that there are no other factors to consider when performing diagnostic assays for Chikungunya. Two (2) respondents (4.44%) indicated that cost and suitability of the test to the locale are other factors to consider.

B. Sensitivity, Specificity and Turnaround Time of the Diagnostic Assays

TABLE X. The Sensitivity, Specificity, and Turnaround Time of the Rapid Immunochromatographic Diagnostic Tests as Perceived by the Respondents

Rapid Immunochromatographic Diagnostic Tests		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	1	4.00%
Low	2	8.00%
Moderate	10	40.00%
High	10	40.00%
Very high	2	8.00%
Total	**25**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	1	4.00%
Low	4	16.00%
Moderate	8	32.00%
High	10	40.00%
Very high	2	8.00%
Total	**25**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	24	96.00%
2-4 days	1	4.00%
5-7 days	0	0.00%
More than a week	0	0.00%
Total	**25**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Rapid Immunochromatographic Diagnostic Test is moderate (40%) to high (40%), while its specificity is perceived to be "high" (40%). Additionally, its turnaround time is perceived to be accomplished "within a day" (96%).

TABLE XI. The Sensitivity, Specificity, and Turnaround Time of the Enzyme-linked Immunosorbent Assay (ELISA) as Perceived by the Respondents

Enzyme-linked Immunosorbent Assay (ELISA)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	3	9.09%
Low	0	0.00%
Moderate	8	24.24%
High	20	60.61%
Very high	2	6.06%
Total	**33**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	4	12.12%
Low	2	6.06%
Moderate	7	21.21%
High	14	42.42%
Very high	6	18.18%
Total	**33**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	18	54.55%
2-4 days	9	27.27%
5-7 days	4	12.12%
More than a week	2	6.06%
Total	**33**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Enzyme-linked Immunosorbent Assay (ELISA) is high (60.61%), while its specificity is also perceived to be "high" (42.42%). Additionally, its turnaround time is perceived to be accomplished "within a day" (54.55%).

TABLE XII. The Sensitivity, Specificity, and Turnaround Time of the Indirect Enzyme-linked Immunosorbent Assay (i-ELISA) as Perceived by the Respondents

Indirect Enzyme-linked Immunosorbent Assay (i-ELISA)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	4	57.14%
High	3	42.86%
Very high	0	0.00%
Total	**7**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	2	28.57%
Moderate	3	42.86%
High	1	14.29%
Very high	1	14.29%
Total	**7**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	2	28.57%
2-4 days	3	42.86%
5-7 days	0	0.00%
More than a week	2	28.57%
Total	**7**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Indirect Enzyme-linked Immunosorbent Assay (i-ELISA) is moderate (57.14%), while its specificity is also perceived to be "moderate"

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(42.86%). Additionally, its turnaround time is perceived to be accomplished in "2-4 days" (42.86%).

TABLE XIII. The Sensitivity, Specificity, and Turnaround Time of the IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA) as Perceived by the Respondents

IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	1	12.50%
Low	1	12.50%
Moderate	1	12.50%
High	5	62.50%
Very high	0	0.00%
Total	**8**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	1	12.50%
Low	1	12.50%
Moderate	1	12.50%
High	4	50.00%
Very high	1	12.50%
Total	**8**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	4	50.00%
2-4 days	2	25.00%
5-7 days	1	12.50%
More than a week	1	12.50%
Total	**8**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with MAC-ELISA is high (62.50%), while its specificity is also perceived to be "high" (50.00%). Additionally, its turnaround time is perceived to be accomplished "within a day" (50.00%).

TABLE XIV. The Sensitivity, Specificity, and Turnaround Time of the Sensitive Epitope-blocking ELISA (EB-ELISA) as Perceived by the Respondents

Sensitive Epitope-blocking ELISA (EB-ELISA)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	0	0.00%
High	2	100.00%
Very high	0	0.00%
Total	**2**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	1	50.00%
High	1	50.00%
Very high	0	0.00%
Total	**2**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	0	0.00%
2-4 days	1	50.00%
5-7 days	0	0.00%
More than a week	1	50.00%
Total	**2**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Sensitive Epitope-blocking ELISA (EB-ELISA) is "high" (100.00%), while its specificity is perceived to be "moderate" (50.00%) to "high" (50.00%). Additionally, its turnaround time is perceived to be accomplished in "2-4 days" (50.00%) or "more than a week" (50.00%).

TABLE XV. The Sensitivity, Specificity, and Turnaround Time of the Indirect Immunofluorescence Tests (IIFT) as Perceived by the Respondents

Indirect Immunofluorescence Tests (IIFT)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	4	80.00%
High	1	20.00%
Very high	0	0.00%
Total	**5**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	3	60.00%
High	1	20.00%
Very high	1	20.00%
Total	**5**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	2	40.00%
2-4 days	1	20.00%
5-7 days	2	40.00%
More than a week	0	0.00%
Total	**5**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Indirect Immunofluorescence Tests (IIFT) is "moderate" (80.00%), while its specificity is also

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perceived to be "moderate" (60.00%). Additionally, its turnaround time is mostly perceived to be accomplished "within a day" (40.00%) or in "5-7 days" (40.00%).

TABLE XVI. The Sensitivity, Specificity, and Turnaround Time of the Polymerase Chain Reaction (PCR) as Perceived by the Respondents

Polymerase Chain Reaction (PCR)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	2	16.67%
High	7	58.33%
Very high	3	25.00%
Total	**12**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	1	8.33%
Low	0	0.00%
Moderate	3	25.00%
High	3	25.00%
Very high	5	41.67%
Total	**12**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	5	41.67%
2-4 days	3	25.00%
5-7 days	4	33.33%
More than a week	0	0.00%
Total	**12**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Polymerase Chain Reaction (PCR) is "high" (58.33%), while its specificity is also perceived to be "very high" (41.67%). Additionally, its turnaround time is mostly perceived to be accomplished "within a day" (41.67%).

TABLE XVII. The Sensitivity, Specificity, and Turnaround Time of the Real Time PCR as Perceived by the Respondents

Real Time PCR		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	1	12.50%
High	4	50.00%
Very high	3	37.50%
Total	**8**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	2	25.00%
High	3	37.50%
Very high	3	37.50%
Total	**8**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	4	50.00%
2-4 days	0	0.00%
5-7 days	4	50.00%
More than a week	0	0.00%
Total	**8**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Real Time PCR is "high" (50.00%), while its specificity is perceived to be "high" (37.50%) to "very high" (37.50%). Additionally, its turnaround time is mostly perceived to be accomplished "within a day" (50.00%) or in "5-7 days" (50.00%).

TABLE XVIII. The Sensitivity, Specificity, and Turnaround Time of the End point PCR (Non-real time PCR) as Perceived by the Respondents

End point PCR (Non-real time PCR)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	1	33.33%
High	1	33.33%
Very high	1	33.33%
Total	**3**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	1	33.33%
Moderate	1	33.33%
High	1	33.33%
Very high	0	0.00%
Total	**3**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	2	66.67%
2-4 days	0	0.00%
5-7 days	1	33.33%
More than a week	0	0.00%
Total	**3**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with End point PCR (Non-real time PCR) is "moderate" (33.33%), "high" (33.33%), or "very high" (33.33%). On the other hand, its specificity is perceived to be "low" (33.33%), "moderate" (33.33%), or "high" (33.33%).

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Additionally, its turnaround time is mostly perceived to be accomplished "within a day" (66.67%).

TABLE XIX. The Sensitivity, Specificity, and Turnaround Time of the Real Time Reverse Transcription PCR as Perceived by the Respondents

Real Time Reverse Transcription PCR		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	1	16.67%
Low	0	0.00%
Moderate	1	16.67%
High	1	16.67%
Very high	3	50.00%
Total	**6**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	1	16.67%
Low	1	16.67%
Moderate	0	0.00%
High	1	16.67%
Very high	3	50.00%
Total	**6**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	3	50.00%
2-4 days	1	16.67%
5-7 days	2	33.33%
More than a week	0	0.00%
Total	**6**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Real Time Reverse Transcription PCR is "very high" (50.00%), while its specificity is also perceived to be "very high" (50.00%). Additionally, its turnaround time is mostly perceived to be accomplished "within a day" (50.00%).

TABLE XX. The Sensitivity, Specificity, and Turnaround Time of the Loop-mediated Isothermal Amplification (LAMP) as Perceived by the Respondents

Loop-mediated Isothermal Amplification (LAMP)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	2	100.00%
High	0	0.00%
Very high	0	0.00%
Total	**2**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	2	100.00%
High	0	0.00%
Very high	0	0.00%
Total	**2**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	0	0.00%
2-4 days	0	0.00%
5-7 days	2	100.00%
More than a week	0	0.00%
Total	**2**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Loop-mediated Isothermal Amplification (LAMP) is "moderate" (100.00%), while its specificity is also perceived to be "moderate" (100.00%). Additionally, its turnaround time is mostly perceived to be accomplished in "5-7 days" (100.00%).

XXI. The Sensitivity, Specificity, and Turnaround Time of the Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP) as Perceived by the Respondents

Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP)		
Scale	***Frequency***	***Percentage***
Sensitivity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	1	50.00%
Moderate	1	50.00%
High	0	0.00%
Very high	0	0.00%
Total	**2**	**100.00%**
Specificity		
Not applicable	0	0.00%
Very low	0	0.00%
Low	0	0.00%
Moderate	0	0.00%
High	2	100.00%
Very high	0	0.00%
Total	**2**	**100.00%**
Turnaround Time		
Not applicable	0	0.00%
Within a day	0	0.00%
2-4 days	2	100.00%
5-7 days	0	0.00%
More than a week	0	0.00%
Total	**2**	**100.00%**

The table shows that the sensitivity as perceived by majority of the respondents who have previous knowledge and/or experience with Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP) is "low"

(50.00%) to "moderate" (50.00%), while its specificity is perceived to be "high" (100.00%). Additionally, its turnaround time is mostly perceived to be accomplished in "2-4 days" (100.00%).

Tables 22 to 33 shows the breakdown of responses on the perception of the respondents on the appropriateness of each of the diagnostics assay. The tabulations are with respect to the total number of respondents that have previous knowledge and/or experience on the assay.

TABLE XXII. Level of appropriateness of Rapid Immunochromatographic Diagnostic Tests

Rapid Immunochromatographic Diagnostic Tests		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	1	4.00%
Neutral	4	16.00%
Slightly appropriate	6	24.00%
Appropriate	11	44.00%
Absolutely appropriate	3	12.00%
Total	**25**	**100.00%**

The table displays that the Enzyme-linked Immunosorbent Assay (ELISA) is perceived to be "appropriate" by the majority of the respondents (60.61%). This is then followed by perceptions of it being "neutral" (15.15%), "absolutely appropriate" (15.15%), and "slightly appropriate" (9.09%).

TABLE XXIII. Level of appropriateness of Enzyme-linked Immunosorbent Assay (ELISA)

Enzyme-linked Immunosorbent Assay (ELISA)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	5	15.15%
Slightly appropriate	3	9.09%
Appropriate	20	60.61%
Absolutely appropriate	5	15.15%
Total	**33**	**100.00%**

The table displays that the Enzyme-linked Immunosorbent Assay (ELISA) is perceived to be "appropriate" by the majority of the respondents (60.61%). This is then followed by perceptions of it being "neutral" (15.15%), "absolutely appropriate" (15.15%), and "slightly appropriate" (9.09%).

TABLE XXIV. Level of appropriateness of Indirect Enzyme-linked Immunosorbent Assay (i-ELISA)

Indirect Enzyme-linked Immunosorbent Assay (i-ELISA)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	3	42.86%
Slightly appropriate	3	42.86%
Appropriate	1	14.29%
Absolutely appropriate	0	0.00%
Total	**7**	**100.00%**

The table displays that the Indirect Enzyme-linked Immunosorbent Assay (i-ELISA) is perceived to be "slightly appropriate" (42.86%) and, at the same time, "neutral" (42.86%) by the majority of the respondents. These are then followed by the perception of it being "appropriate" (14.29%).

TABLE XXV. Level of appropriateness of IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA)

IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	2	25.00%
Slightly appropriate	2	25.00%
Appropriate	3	37.50%
Absolutely appropriate	1	12.50%
Total	**8**	**100.00%**

The table displays that the IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA) is perceived to be "appropriate" (37.50%) by the majority of the respondents. This is then followed by the perceptions of it being "slightly appropriate" (25%), "neutral" (25%), and "absolutely appropriate" (12.50%).

TABLE XXVI. Level of appropriateness of Sensitive Epitope-blocking ELISA (EB-ELISA)

Sensitive Epitope-blocking ELISA (EB-ELISA)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	1	50.00%
Slightly appropriate	0	0.00%
Appropriate	1	50.00%
Absolutely appropriate	0	0.00%
Total	**2**	**100.00%**

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The table displays that the Sensitive Epitope-blocking ELISA (EB-ELISA) is perceived to be both "appropriate" (50%) and, at the same time, "neutral" (50%) by the majority of the respondents.

TABLE XXVII. Level of appropriateness of Indirect Immunofluorescence Tests (IIFT)

Indirect Immunofluorescence Tests (IIFT)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	3	60.00%
Slightly appropriate	1	20.00%
Appropriate	1	20.00%
Absolutely appropriate	0	0.00%
Total	**5**	**100.00%**

The table displays that the Indirect Immunofluorescence Tests (IIFT) is perceived to be "neutral" (60%) in terms of its appropriateness by the majority of the respondents. This is then followed by the perceptions of it being "slightly appropriate" (20%) and "appropriate" (20%).

TABLE XXVIII. Level of appropriateness of Polymerase Chain Reaction (PCR)

Polymerase Chain Reaction (PCR)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	1	8.33%
Slightly appropriate	2	16.67%
Appropriate	7	58.33%
Absolutely appropriate	2	16.67%
Total	**12**	**100.00%**

The table displays that the Polymerase Chain Reaction (PCR) is perceived to be "appropriate" (58.33%) by the majority of the respondents. This is then followed by the perceptions of it being "slightly appropriate" (16.67%), "absolutely appropriate" (16.67%), and "neutral" (8.33%).

TABLE XXIX. Level of appropriateness of Real Time PCR

Real Time PCR		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	0	0.00%
Slightly appropriate	1	12.50%
Appropriate	5	62.50%
Absolutely appropriate	2	25.00%
Total	**8**	**100.00%**

The table displays that the Real Time PCR is perceived to be "appropriate" (62.5%) by the majority of the respondents. This is then followed by the perceptions of it being "absolutely appropriate" (25%) and "neutral" (12.50%).

TABLE XXX. Level of appropriateness of End Point PCR (Non-real time PCR)

End Point PCR (Non-real time PCR)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	2	66.67%
Slightly appropriate	1	33.33%
Appropriate	0	0.00%
Absolutely appropriate	0	0.00%
Total	**3**	**100.00%**

The table displays that the End Point PCR (Non-real time PCR) is perceived to be "neutral" (66.67%) in terms of its appropriateness by the majority of the respondents. This is then followed by the perception of it being "slightly appropriate" (33.33%).

TABLE XXXI. Level of appropriateness of Real Time Reverse Transcription PCR

Real Time Reverse Transcription PCR		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	1	16.67%
Slightly appropriate	0	0.00%
Appropriate	1	16.67%
Absolutely appropriate	4	66.67%
Total	**6**	**100.00%**

The table displays that the Real Time Reverse Transcription PCR is perceived to be "absolutely appropriate" (66.67%) by the majority of the respondents. This is then followed by the perception of it being "appropriate" (16.67%) and "neutral" (16.67%).

TABLE XXXII. Level of appropriateness of Loop-mediated Isothermal Amplification (LAMP)

Loop-mediated Isothermal Amplification (LAMP)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	2	100.00%
Slightly appropriate	0	0.00%
Appropriate	0	0.00%
Absolutely appropriate	0	0.00%
Total	**2**	**100.00%**

The table displays that the Loop-mediated Isothermal Amplification (LAMP) is perceived to be "neutral" (100%) in terms of its appropriateness by the respondents.

TABLE XXXIII. Level of appropriateness of Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP)

Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP)		
Scale	***Frequency***	***Percentage***
Not applicable	0	0.00%
Absolutely inappropriate	0	0.00%
Inappropriate	0	0.00%
Slightly inappropriate	0	0.00%
Neutral	2	100.00%
Slightly appropriate	0	0.00%
Appropriate	0	0.00%
Absolutely appropriate	0	0.00%
Total	**2**	**100.00%**

The table displays that the Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP) is perceived to be "neutral" (100%) in terms of its appropriateness by the respondents.

C. Correlational Analysis of the Sensitivity, Specificity, and Turnaround Time on Appropriateness for each of the Diagnostic Assays

Tables 34 to 45 displays the correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the diagnosis of chikungunya based on the perception of the medical technologist by using the Spearman rank-order correlation coefficient (Spearman's correlation). A 0.05 level of significance was utilized for the correlational analysis. P-values that are less than or equal to 0.05 are considered to be statistically significant, however, those that are greater than 0.05 provide no sufficient evidence to conclude that the association between the factors are significant.

TABLE XXXIV. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Rapid Immunochromatographic Diagnostic Tests

Rapid Immunochromatographic Diagnostic Tests		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0.4947192	0.01193
Specificity and Appropriateness	0.4348113	0.02985
Turnaround Time and Appropriateness	0.1195827	0.5691

The results for the Rapid Immunochromatographic Diagnostic Tests [Table 34] shows that there is a statistically significant low positive correlation between its sensitivity and appropriateness (r=0.4947192, p-value=0.01193) as well as between its specificity and appropriateness (r=0.4348113, p-value=0.02985); and, there is no sufficient evidence to conclude that the association of its turnaround time and appropriateness (r=0.1195827, p-value=0.5691) is statistically significant at 0.05 level of significance.

TABLE XXXV. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Enzyme-linked Immunosorbent Assay (ELISA)

Enzyme-linked Immunosorbent Assay (ELISA)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0.02801124	0.877
Specificity and Appropriateness	0.1872308	0.2968
Turnaround Time and Appropriateness	-0.4260254	0.01343

The results for the Enzyme-linked Immunosorbent Assay (ELISA) shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=0.02801124, p-value=0.877) as well as the association of its specificity and appropriateness (r=0.1872308, p-value=0.2968) is statistically significant at 0.05 level of significance; and, there is a statistically significant low negative correlation between its turnaround time and appropriateness (r=-0.4260254, p-value=0.01343).

TABLE XXXVI. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Indirect Enzyme-linked Immunosorbent Assay (i-ELISA)

Indirect Enzyme-linked Immunosorbent Assay (i-ELISA)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0.3118048	0.496
Specificity and Appropriateness	-0.2425356	0.6003
Turnaround Time and Appropriateness	-0.1020621	0.8276

The results for the Indirect Enzyme-linked Immunosorbent Assay (i-ELISA) shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=0.3118048, p-value=0.496), specificity and appropriateness (r=-0.2425356, p-value=0.6003), and turnaround time and appropriateness (r=-0.1020621, p-value=0.8276) are statistically significant at 0.05 level of significance.

TABLE XXXVII. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA)

IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0.2123019	0.6137
Specificity and Appropriateness	0.5264981	0.1801
Turnaround Time and Appropriateness	0.2385414	0.569

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The results for the IgM Antibody Capture Enzyme-linked Immunosorbent Assay (MAC-ELISA) shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=0.2123019, p-value=0.6137), specificity and appropriateness (r=0.5264981, p-value=0.1801), and turnaround time and appropriateness (r=0.2385414, p-value=0.569) are statistically significant at 0.05 level of significance.

TABLE XXXVIII. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Sensitive Epitope-blocking ELISA (EB-ELISA)

Sensitive Epitope-blocking ELISA (EB-ELISA)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	NA	NA
Specificity and Appropriateness	NA	NA
Turnaround Time and Appropriateness	NA	NA

The table displays that the coefficients and p-values were failed to be computed for the Sensitive Epitope-blocking ELISA (EB-ELISA).

TABLE XXXIX. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Indirect Immunofluorescence Tests (IIFT)

Indirect Immunofluorescence Tests (IIFT)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	-0.3952847	0.5101
Specificity and Appropriateness	-0.125	0.8413
Turnaround Time and Appropriateness	0.5303301	0.3579

The results for the Indirect Immunofluorescence Tests (IIFT) shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=-0.3952847, p-value=0.5101), specificity and appropriateness (r=-0.125, p-value=0.8413), and turnaround time and appropriateness (r=0.5303301, p-value=0.3579) are statistically significant at 0.05 significance level.

TABLE XL. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Polymerase Chain Reaction (PCR)

Polymerase Chain Reaction (PCR)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0.06622662	0.838
Specificity and Appropriateness	0.321601	0.308
Turnaround Time and Appropriateness	0.02503131	0.9385

The results for the Polymerase Chain Reaction (PCR) shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=0.06622662, p-value=0.838), specificity and appropriateness (r=0.321601, p-value=0.308), and its turnaround time and appropriateness (r=0.02503131, p-value=0.9385) are statistically significant at 0.05 significance level.

TABLE XLI**.** Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Real Time PCR (RT-PCR)

Real Time PCR (RT-PCR)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	-0.06776309	0.8733
Specificity and Appropriateness	0.2909572	0.4845
Turnaround Time and Appropriateness	-0.1889822	0.654

The results for the Real Time PCR [Table 40] shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=-0.06776309, p-value=0.8733), specificity and appropriateness (r=0.2909572, p-value=0.4845), and turnaround time and appropriateness (r=-0.1889822, p-value=0.654) are statistically significant at 0.05 significance level.

TABLE XLII. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the End point PCR (Non-real time PCR)

End point PCR (Non-real time PCR)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0	1
Specificity and Appropriateness	0	1
Turnaround Time and Appropriateness	-0.5	0.6674

The results for the End point PCR (Non-real time PCR) shows that there is no sufficient evidence to conclude that the association of its specificity and appropriateness (r=0, p-value=1), specificity and appropriateness (r=0, p-value=1), and turnaround time and appropriateness (r=-0.5, p-value=0.6674) are statistically significant at 0.05 significance level.

TABLE XLIII. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Real Time Reverse Transcription PCR

Real Time Reverse Transcription PCR		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	0.4669738	0.3505
Specificity and Appropriateness	0.4669738	0.3505
Turnaround Time and Appropriateness	0.6572671	0.1561

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The results for the Real Time Reverse Transcription PCR shows that there is no sufficient evidence to conclude that the association of its sensitivity and appropriateness (r=0.4669738, p-value=0.3505), specificity and appropriateness (r=0.4669738, p-value=0.3505), and turnaround time and appropriateness (r=0.6572671, p-value=0.1561) are statistically significant at 0.05 level of significance.

TABLE XLIV. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Loop-mediated Isothermal Amplification (LAMP)

Loop-mediated Isothermal Amplification (LAMP)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	NA	NA
Specificity and Appropriateness	NA	NA
Turnaround Time and Appropriateness	NA	NA

The table displays that the coefficients and p-values were failed to be computed for the Loop-mediated Isothermal Amplification (LAMP).

TABLE XLV. Correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its level of appropriateness on the Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP)

Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP)		
Variables	***Correlation Coefficient***	***p-value***
Sensitivity and Appropriateness	NA	NA
Specificity and Appropriateness	NA	NA
Turnaround Time and Appropriateness	NA	NA

The table displays that the coefficients and p-values were failed to be computed for the Dried Reverse Transcription Loop-mediated Isothermal Amplification (RT-LAMP).

D. Importance of appropriate diagnostic assay for chikungunya

Fig. 1. Importance of Diagnostic Assays for Chikungunya as Perceived by the Respondents (Word Cloud)

TABLE XLVI. Importance of Diagnostic Assays for Chikungunya as Perceived by the Respondents

Word	***Frequency***	***Percentage***	***Rank***
chikungunya	16	3.65%	1
disease	13	2.97%	2
diagnose	11	2.51%	3
dengue	10	2.28%	4
diagnosis	10	2.28%	4
assay	7	1.60%	7
order	7	1.60%	7
patient	7	1.60%	7
accurate	6	1.37%	10
important	6	1.37%	10

The answers to the open-ended question were assessed through the use of MAXQDA Qualitative Data Analysis. The words with a high frequency among the answers of the respondents appear to be more prominent in the word cloud as shown in Figure 1. The table also displays the words “chikungunya” (n=16), “disease” (n=13), and “diagnose” (n=11) which are the three main recurring themes among the answers of the respondents.

V. DISCUSSION

A. Demographics

Assessing the perception of medical technologists from clinical laboratories in Metro Manila and Rizal on the sensitivity, specificity, turnaround time, and appropriateness of diagnostic assays for Chikungunya virus was the aim of this study. Based on the demographic profile in Table 1, 75.56% of the respondents were from Metro Manila (n=34) while 24.44% were from Rizal (n=11). Most of the respondents in Table 2, 82.22% indicated that CHIKV testing is not part of their routine National External Quality Assurance Scheme (NEQAS) (n=37) while 17.78% of respondents had CHIKV as part of their National External Quality Assurance Scheme (NEQAS) (n=8). The data in Table 3 showed that 35.56% of the respondents served at laboratories of private hospitals (n=16), 28.89% served at government hospitals (n=13), 24.44% served at free-standing hospitals (n=11), and 11.11% served at other laboratories such as city health office, rural health unit, and swabbing facility (n=5). Senior medical technologists (66.67%) were mostly the ones who were managing the Chikungunya testing inside the laboratory which was shown in Table 4. A total of 36 out of 45 respondents (80%) answered “Yes” in Table 5 when it comes to availability of diagnostic tests for Chikungunya infection inside their laboratory. A considerable amount of respondents (95.56%) agreed that absences of diagnosis lead to difficulties in managing infections which was shown in Table 6.

B. Sensitivity, Specificity and Turnaround Time of the Diagnostic Assays

Looking at the responses given by the respondents, Table 7 showed which of the 3 factors (sensitivity, specificity, and turnaround time) did the RMTs consider as the most important in their determination of a suitable diagnostic assay for Chikungunya virus diagnosis. Results

revealed that they perceived sensitivity as the most important factor followed by specificity and lastly turnaround time. Reference [6] shows that their responses revealed that it had been influenced by top-down processing. Their collective past experiences and prior knowledge of the test deemed sensitivity to be the most important factor out of the 3 while turnaround time was the least important factor. This shows that when determining a suitable assay for CHIKV, they often looked at the sensitivity and specificity of the assay rather than the turnaround time. Table 8 displayed the diagnostic assays that the RMT's have previously used or have previous knowledge on for CHIKV diagnosis. ELISA was seen to be the most used/known (n=33) followed by Rapid (n=25) then PCR (n=12) followed by the rest of the tests. None of the respondents have had previous knowledge/experience on the usage of MNA, PRNT, PBNA, PLVBNA, SYBR Green and RT-RPA therefore one could not be able to assess their perceptions about these. A reason for this would be that there was an insufficient amount of respondents that had previous experience or knowledge about these assays. The perception of the sensitivity, specificity and turnaround time of each assay were then assessed (Table 9). For the rapid immunochromatographic diagnostic test's sensitivity, the respondent's perception revealed that out of 25 responses, there were an equal number of respondents that rated the assay as "High" and "Moderate" (n=10). Reference [2] agrees with the perception of the respondents regarding the sensitivity of the assay. In their study, it was stated that there are commercially available immunochromatographic kits that can detect CHIKV with high sensitivity. The perception of the respondents based on the sensitivity of the assay may have been influenced by research and studies that they have previously read. As for specificity, 10 out of 25 respondents perceived the specificity of the assay to be "High". Reference [2]'s data agrees with their perception of "High specificity", it showed that there were no cross reactions with DENV. The perceptions on turnaround time revealed that majority of the respondents (n=24) perceived TAT to be within a day.

For the enzyme-linked immunosorbent assay diagnostic test's sensitivity, the respondent's perception revealed that out of 33 responses, 20 respondents rated the assay as "High". For specificity, 14 out of 33 responses also rated the assay as "High". Reference [24] supports their perception, which involved testing ELISA's sensitivity and specificity. In their study, it was shown that the sensitivity and specificity was shown to be above 70%. The perception of turnaround time revealed that majority (n=18) perceived the turnaround time of ELISA was within the day. Reference [14] agrees with the the perception of the respondents in which it showed that the turnaround time of this specific assay appeared to be within 180-200 minutes.

Among the 7 respondents of i-ELISA, their perceptions for the assay's sensitivity ranged from moderate to high with the majority perceiving it as moderate (n=4). Reference [15] was shown to have varying data as compared with the majority's perception. In the study, they mentioned that the i-ELISA yielded a sensitivity of 85% which is considered high. The range for the perception of the assay's specificity was more spread out than the sensitivity wherein 3 respondents perceived it as moderate, 2 respondents perceived it as Low and 1 each perceived the specificity as High and Very High. It was revealed that the specificity of this specific assay was 89%[15]. The majority's perception of "moderate" varied from the information seen in the previous journal. The perception on turnaround time revealed that the majority perceived the assay's TAT to be 2-4 days. Reference [15] revealed that a result could be seen within 220 minutes.

A total of 8 respondents were able to provide their perception about MAC-ELISA. In regard to the sensitivity and specificity, the majority of the respondents perceived the assay as "High". Reference [11]'s findings contradicts the respondents's perception being "High". In the study, it was seen that most existing MAC-ELISA tests showed increased cross reactions with other related alphaviruses. However, depending on the sample used such as acute or convalescent sera, it could detect IgM antibodies and yield high specificity as well as sensitivity. Most of the respondents perceived the TAT of the assay to be within a day, this finding does not vary from the same study mentioned earlier In the study, it was seen that rapid results were produced within less than two to three hours.

Two (2) respondents were able to give their perception about EB-ELISA. All of the respondents perceive the sensitivity of the assay to be high. Out of the 2 respondents, each perceived the assay's specificity to be moderate and high. Reference 11's findings relate to the perception given by the respondents towards the sensitivity and specificity of the assay In the study, EB-ELISA's mechanism prevents cross reactivity which allows high sensitivity and specificity in the detection of CHIKV antibodies in human sera. The perception of the turnaround time of the assay turned to be either 2-4 days or more than a week. This finding varies from the data gathered by the same study. In the study, the EB-ELISA assay was concluded to be "rapid, simple, highly-sensitive and specific assay that is also cost-effective and safe". The perception of the respondents contradicted the fact that EB-ELISA is considered to be a rapid test.

A total of 5 respondents had knowledge on IIFT of which 4 respondents perceived the sensitivity of the assay as "Moderate" while for specificity, 3 respondents perceived it also as "Moderate". Reference [21]'s findings were used to relate with the perception of the respondents. The study mentioned that IIFT has high sensitivity and specificity in connection with ELISA since the assay utilizes CHIKV-infected and uninfected cell substrates that are coated on separate biochips. The turnaround time was perceived to be either "Within a day" or "5-7 days" by 2 respondents each. The usual turnaround time for the assay is 4 days and 19 hours and can be shortened to 2 days and 32 hours[7]. The perception of the respondents contradicted the sensitivity, specificity, and turnaround time for the assay.

The results for the perception of the sensitivity for PCR revealed that 7 out of 12 the respondents perceived the assay to have "High" sensitivity. On the other hand, for specificity, majority (n=5) perceived the assay to be "Very High". PCR is

considered to be a reliable and fast diagnostic technique[4]. The perceptions of the respondents match the description "reliable" as said in the previous study. The perceptions of the turnaround time for PCR were divided between "Within a day" (n=5), "2-4 days" (n=3) and "5-7 days" (n=4). Since CHIKV is an RNA virus, PCR's more advanced mechanism (RT-PCR) is commonly used. Reference [18]'s findings agree with the majority of the respondetns's perception on the turnaround time of the assay. In the study, their RT-PCR assay provided a result within 110 minutes.

The results for the perception of real time PCR showed that the respondents were leaning towards the idea of the assay having high or higher sensitivity and specificity. The turnaround time for real time PCR was perceived by the respondents as either "Within a day" or "5-7 days". Reference [22] was used to relate with the perception of the respondents regarding the sensitivity and specificity of the assay where it stated that real-time PCR in relation to PCR has higher sensitivity and specificity. Real-time PCR is more automated than PCR. The assay has shorter test turnaround time, optimization experiments can be performed within hours instead of days[9]. Half of the respondents had the wrong perception for the turnaround time for the assay.

The perception of the respondents about the sensitivity of End point PCR are spread out between "Moderate", "High" and "Very High". Since there were only 3 respondents, the perception of the assay's specificity also varied from "Low", "Moderate" and "High". The turnaround time of this assay was perceived by 2 out of 3 of the respondents to be within a day. End-point PCR was concluded to be less sensitive and precise as compared to real-time PCR[10]. End-point PCR is also known to be time consuming[10]. Determining whether or not the perceptions of the respondents contradict or agree to the data gathered from a previous study would be difficult due to limited and varied responses.

The perception of the respondents seen in the survey showed that they perceive real time reverse transcription pcr's sensitivity and specificity to be "Very High" (n=3). Reference [18]'s findings agree with the perception of the respondents. The study revealed that the sensitivity of real time reverse transcription pcr's sensitivity and specificity reaches 100%. 3 out of the six respondents perceive the turnaround time to be within a day. They discovered that the turnaround time for results for the assay was within 110 minutes[18].

Only 2 respondents were able to provide their perception on LAMP's sensitivity, specificity, and turnaround time. The results of their perception for sensitivity and specificity revealed that they perceived the assay as both moderate. It was found that the sensitivity and specificity of the lamp assay to be 100% which is considered very high for the detection of CHIKV[16]. The perception of the respondents contradict the findings. The respondents perceived the turnaround time to be within 5-7 days. Reference [16]'s data gathered varied from the perceptions seen from the respondents. In the study, it was discovered that when LAMP method is utilized, test results are available within 30-45 minutes.

Similar to LAMP, 2 respondents were able to provide their perception about RT-LAMP's sensitivity, specificity, and turnaround time. The perception of the sensitivity of RT-LAMP was either low or moderate however the specificity was "High". Reference [22]'s data contradicts the perceived sensitivity of the RT-LAMP assay. In the study, they compared the sensitivity of RT-LAMP from RT-PCR and the former achieved a higher sensitivity because it was able to pick up on lower levels of the virus seen in additional samples. The sensitivity of the assay was about 70% for RNA samples and 58% for serum samples[13]. Reference [22]'s agree with the perception of the respondents regarding the specificity of the assay. The RT LAMP was able display a high degree of specificity as it produced negative results when tested with other related viruses[22]. The perception of the respondents about the turnaround time for this assay revealed that they perceive it to be "2-4 days". Reference [18] revealed that RT-LAMP reaction can be finished within 1 hour if done under isothermal conditions which was different from the perception of the respondents.

C. Correlations of Sensitivity, Specificity, and Turnaround Time on the Appropriateness of the Diagnostic Assay

The correlation of factors considered (sensitivity, specificity, and turnaround time) in a diagnostic assay and its level of appropriateness for the diagnosis of chikungunya based on the perception of the medical technologist was one of the objectives of the study. The significance of the correlation coefficients were also tested at a 0.05 level of significance which indicates that correlation coefficients with p-values that are less than or equal to 0.05 are said to be statistically significant at 0.05 level of significance. Otherwise, if the p-value is greater than 0.05, one can say that there is no sufficient evidence to conclude that there is significant relationship or association between the two variables of interest at 0.05 level of significance. This was applied to the results obtained by the researchers and the statistical analysis revealed that only the Rapid Immunochromatographic Diagnostic Test and the ELISA were found to be statistically significant. Furthermore, the diagnostic assays, Sensitive Epitope-blocking ELISA, LAMP, and the RT-LAMP, cannot be accommodated by the test (Spearman's correlation) and resulted in an error during the statistical analysis of the data due to the limited number of data collected.

The data analyzed in the study indicated that for some tests there exists a correlation and is statistically significant. This indicates that there is a connection between the perceptions of the factors (sensitivity, specificity, and turnaround time) to how appropriate the test was for the diagnosis of chikungunya. The appropriateness of tests depended on various factors that included the clinical diagnosis of the patient, severity of disease, effectiveness of the diagnostic test and many more[5]. The study also stated that the relationship between appropriateness and medical outcome consisted of 2 kinds of visions, an 'essentialist' one focused on results, their validity and accuracy and

'consequentialist' one focused on the value of consequences on health, their utility, and outcomes. There are two principal points of appropriateness in laboratory medicine, the foundation of appropriateness that was built on evidence-based laboratory medicine and the appropriateness that existed in the quality of every phase of the total testing process. The total testing process consisted of pre-pre-analytical, pre-analytical, analytical, post-analytical, and post-postanalytical phases. One way of improving the quality of the analytical phase is by verification of analytical sensitivity and specificity[1]. Appropriateness can be considered to have a relationship with both sensitivity and specificity since these two factors are part of the analytical phase. Furthermore, turnaround time was described as the steps in performing a laboratory test which was stated to be outlined by Lundberg, who described the brain to brain TAT or "total testing cycle"[12].

The Rapid Immunochromatographic Diagnostic Tests revealed a statistically significant low positive correlation between its sensitivity and appropriateness (r=0.4947192, p-value=0.01193) and between its specificity and appropriateness (r=0.4348113, p-value=0.02985). Since the p-value of the correlation coefficient of its sensitivity and appropriateness is 0.01193 and its specificity and appropriateness is 0.02985, which is less than 0.05, there is sufficient evidence to conclude that the association of its sensitivity and appropriateness is statistically significant at 0.05 level of significance. Moreover, it indicates a low positive relationship based on the rule of thumb for interpreting the size of a correlation coefficient[19]. The positive correlation coefficient is indicative that the variables are directly related to each other wherein as the value of one variable goes up, the value of the other also tends to increase [19]. These results indicate that as the perception of the respondents on the sensitivity and specificity of the assay increases, their perception on its appropriateness also increases. Sensitivity was defined as "the proportion of true positives that are correctly identified by a diagnostic test."[30] This factor demonstrates the performance of the test in detecting a disease. On the other hand, they also defined specificity as "the proportion of the true negatives correctly identified by a diagnostic test," which simply suggests the performance of the test in identifying a normal or negative condition with regards to the disease in concern. With these, the results of the study has revealed that the medical technologists perceive the Rapid Immunochromatographic Diagnostic Test to be more appropriate if its sensitivity and specificity is also high.

In addition, the results for the ELISA only revealed a statistically significant low negative correlation between its turnaround time and appropriateness (r=-0.4260254, p-value=0.01343). Likewise, since the p-value of turnaround time and appropriateness is 0.01343, which is less than 0.05, there is sufficient evidence to conclude that the association of its turnaround time and appropriateness is statistically significant at 0.05 level of significance. Moreover, there is a low negative relationship between turnaround time and appropriateness. This indicates that as the perception of the respondents on its turnaround time increases (it takes a longer time), the perception of the appropriateness of ELISA decreases. Turnaround time has varied definitions among the laboratory and clinicians, however, it is often defined as the "the time taken to complete a test."[23] Given the results of the study, it has revealed that the medical technologists perceive the ELISA to be more appropriate if its turnaround time is low or decreased since this will allow them to process and release the results to the patient and physician in a timely manner.

VI. CONCLUSION

Overall, the study identified, analyzed, and assessed the perceptions of medical technologists on the diagnostic assays utilized for chikungunya in clinical laboratories around Metro Manila and Rizal. The results suggest that the majority of the respondents considered sensitivity as the most important factor in the determination for a suitable diagnostic assay for the diagnosis of chikungunya.

Based on the different diagnostic assays utilized in clinical laboratories, ELISA was seen to be the most utilized or sought-after (n=33). It is then followed by the Rapid Immunochromatographic Diagnostic Test (n=25), then PCR (n=12), and the rest followed. However, other diagnostic assays (MNA, PRNT, PBNA, PLVBNA, SYBR Green and RT-RPA) could not be assessed due to respondents having no previous experience or knowledge of these assays.

The researchers have assessed that the majority of the medical technologists perceive the different diagnostic assays as having a moderate to high sensitivity and specificity. However, for the sensitivity of the Real Time Reverse Transcription PCR and End point PCR, they were the only ones that showed a very high and varied sensitivity, respectively. For the specificity, the PCR, Real Time PCR, and Real Time Reverse Transcription PCR are the only assays that were perceived to have a very high specificity while the End point PCR showed a varied response. Lastly, the turnaround time was perceived to be accomplished within a day. However, there were some responses that the i-ELISA, EB-ELISA, RT-LAMP were done for 2-4 days and the LAMP was done for 5-7 days. The IIFT and Real Time PCR had varied responses (within a day and 5-7 days) with regards to its turnaround time as suggested by the data gathered.

When it came to the level of appropriateness, Rapid Immunochromatographic Diagnostic Test, ELISA, MAC-ELISA, EB-ELISA, PCR and Real Time PCR were perceived to be appropriate. i-ELISA was perceived to be equally slightly appropriate and neutral. A neutral level of appropriateness was seen in IIFT, End Point PCR, LAMP and RT LAMP. Only Real Time Reverse Transcription PCR was perceived to be absolutely appropriate.

The correlation between the factors considered (sensitivity, specificity, turnaround time) in a diagnostic assay and its appropriateness as perceived by the medical technologists was statistically analyzed through the Spearman rank-order correlation which only yielded a statistically

significant result in the Rapid Immunochromatographic Diagnostic Test and ELISA.

In conclusion, the perception of medical technologists towards the different assays for chikungunya virus was found to be conclusive with regards to the Rapid Immunochromatographic Diagnostic Test and ELISA as it was able to produce a correlation between perceived sensitivity, specificity, turnaround time and perceived appropriateness. The rest of the assays had insufficient responses to be able to conclude any correlation. The variety of different chikungunya tests is important to any clinical laboratory to be able to choose the appropriate test based on sensitivity, specificity, and turnaround time.

VII. RECOMMENDATION

The following recommendations can be made for future studies: The future researchers should have a greater sample size and to widen the scope of location, not only focusing on clinical laboratories in Metro Manila and Rizal for a better comparison of different chikungunya diagnostic tests. The researchers also suggest that the collection of data and responses be led in an extended timeframe in order to reach the intended sample size for the research.

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