Knowledge, Attitude, and Practices on Laboratory Quality Assurance Among Medical Technologists in Selected Level III Hospitals in Davao City

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Abstract: - Quality assurance is essential in every institution, particularly in a laboratory setting to achieve and maintain quality, reliable, relevant, and timely test results. Despite the compliance in many laboratories in the Philippines, data presented by surveys such as the Asia Pacific Accreditation Cooperation (APAC) showed that more than 50% of laboratories did not pursue accreditation. In this study, the researchers assessed the knowledge, attitude, and practices on laboratory quality assurance among medical technologists in selected level III hospitals in Davao City. A descriptive quantitative study and inferential statistical research tools were used as the research design. Survey questionnaires were utilized to draw data from the respondents coming from Brokenshire hospital and Southern Philippines Medical Center in Davao city. Data gathered were encoded in Microsoft Excel and analyzed using Microsoft Excel, R, and SPSS. The findings of this study showed that some statements were answered incorrectly in terms of knowledge. Meanwhile regarding attitude, an absolute majority (100%) concur that practicing quality assurance significantly contributes to customer satisfaction, accurate processes and results, increased quality of output, performance improvement and efficiency, collaboration, personal responsibility, and professional growth. In terms of practice, most of the respondents were compliant. Regarding perceived impediments, most respondents attributed quality assurance to be time-consuming (36%), costly (63%), requiring extra credentials, advanced skills, and additional training (58%). As to sociodemographic factors, educational attainment ($p=0.163$), income ($p=0.286$), position ($p=0.026$), and length of practice ($p=0.373$) did not affect the practice of respondents ($p>0.05$). This study recommends the assessment of the correlation between the knowledge, attitudes and practices, and to further correlate knowledge and attitudes with the sociodemographic factors.

Key Words: — *Quality assurance, Medical technologist, Descriptive, Quantitative, Inferential.*

I. Background of the Study

A. Introduction

Medical laboratories are sources of information and services needed to maximize the effectiveness of healthcare delivery, especially in a complex health system like in the Philippines. Information in the laboratory involves the knowledge and skills of medical technologists and physicians in evidence-based decision-making to arrive at results significant for patient diagnosis and identification of abnormalities and provide appropriate treatment and care to patients. The laboratory services include identifying suitable specimens, reagents, equipment, materials and utilizing a health information system. In general, patient safety, resource utilization, and customer satisfaction are aimed at the laboratory. Most clinical laboratories, nowadays, continually improve and progress proportionally to the advancement of technologies, wherein new machines and equipment almost do the roles of medical technologists.

Along with these advancements are the changes happening inside and outside the laboratory, which include the workflow and the testing procedures. Medical technologists are expected to perform different tests and adapt and cope with these

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changes. In contrast, as laboratory productivity progresses, novel diseases and new disease strains motivate the need for more tests. This may be due to the changes brought about by globalization regarding the rate of spread of diseases, viruses, and new adaptable changes of microorganisms (American Society for Clinical Laboratory Sciences, 2005).

It is important to note that these changes may bring different errors and mistakes inside the laboratory. This is where the constant assessments and adjustments of the laboratory work plan come into play – routine calibration checks and performing control charting diagnosis. In the Philippines, clinical laboratories are being regulated by setting standards for various laboratory services. Consequently, accreditation for laboratories was instituted by the Philippine Council for Accreditation of Healthcare Organizations (PCAHO) by approving the standards of different hospitals in providing quality medical services (Maramba, 2002). Nevertheless, the primary foundations of clinical laboratories are the medical technologists, for they perform tests and provide results to deliver quality healthcare services. Hence, they are expected to be timely updated, , be consistently skilled, and be mindful of the laboratory workflow and plan.

By principle, Quality Assurance (Q.A.) is used to achieve and maintain quality, reliable, relevant, and timely test results in both external and internal practices, which involve the analytical, preanalytical, and post-analytical phases of the laboratory. It incorporates testing the suitable specimen of the patient at the appropriate time to acquire accurate results for interpretation (Rahman, 2011). According to the Department of Health (DOH, 2013a, 2013b), the list of licensed or accredited health facilities in Davao City is divided into non-hospital-based and hospital-based clinical laboratories. In the City of Davao, there are seventy-five non-hospital-based clinical laboratories, whereas there are twenty-five hospital-based clinical laboratories. The required sections in a primary laboratory are Microscopy and Hematology, while Microscopy, Hematology, Clinical Chemistry, and Immunology and Serology are required in the secondary laboratory. Lastly, all sections in the secondary laboratory, and the Microbiology (Processing and Media Preparation room) and Histopathology sections are included in the tertiary laboratory (DOH, 2016). According to Theodorsson (2016), in a Clinical Chemistry Laboratory, knowledge, skills, and common sense are critical aspects for quality assurance.

Whereas, the practices of employees, including their interactions with patients, are essential for the overall result of the complete testing chain. The phases in the laboratory are accomplished and further improved with changing attitudes and behaviors. Furthermore, in a Hematology Laboratory, quality assurance is used to achieve reliable results from tests. This includes internal quality control, external quality assessment, use of standard methods, and monitoring of capabilities through evaluations and control materials (Lewis, n.d.). Adding up to the information mentioned above, according to Arora (2004), quality assurance in a Microbiology Laboratory ensures that the laboratory results are given accurately. The preanalytical, analytical, and post-analytical phases should be integrated with the standard operating procedures. The environmental factors and the materials and equipment must be tested and verified to control the errors in accomplishing the tests. In a Histopathology Laboratory, quality assurance is the systematic evaluation of quality control results and parameters to achieve a fully operating system by giving quality health care delivery. It detects and controls the errors occurring by accessing all the steps and practices performed inside the laboratory to prevent, reduce, and correct deficiencies in the processes (Odega, 2015).

Based on the study of Badrick, Habijanic, Mah, and Arcellana-Nuqui (2019) on the Philippines Diagnostic Pathology Laboratory Benchmarking, the Asia Pacific Accreditation Cooperation (APAC) survey showed less than half of laboratories (47%) in the country pursued accreditation to ISO 15189 or ISO 9001, an international standard for the quality management of medical laboratories, and only 50% on the External Quality Assurance (EQA) program out of one-hundred six laboratories (2015-2017). Private hospital laboratories (58%) comprise most accredited ones, implying that accredited government hospital laboratories are few. Consequently, the Philippines has fewer sites with Lean Six Sigma improvement deployment. From this study, it seems clear that most laboratories in the Philippines need quality improvements to provide safe, relevant, reliable, and timely test results once they accomplish accreditation at an international or national level.

Quality assurance includes all the components that influence the production of accurate results in all health laboratory services, which would also include laboratories in level III hospitals. The health laboratories carry out the two components, internal quality control, and external quality assessment scheme to ensure the continuous and accurate process to be performed daily, as well as to compare the results among laboratories to

see possible variables that may affect the result in the laboratory (WHO, 2003).

In this light, the research was conducted to assess medical technologists' knowledge, attitude, and practices in tertiary hospitals in Davao City toward laboratory quality assurance and to correlate specific sociodemographic factors on their practices of laboratory quality assurance. The researchers assessed if significant changes should be made to improve the quality of clinical practice in Davao City.

B. Objectives of the Study

Generally, the researchers assessed medical technologists' knowledge, attitude, and practices on laboratory quality assurance programs in selected level III hospitals in Davao City. Specifically, the researchers were able to:

- To determine the perception of the medical technologists in selected level III hospitals in Davao City on laboratory quality assurance in terms of knowledge, attitude, and practice,
- To identify the main perceived impediments affecting the practices of medical technologists in selected level III hospitals in Davao City on laboratory quality assurance, and
- To correlate sociodemographic factors to the practice of medical technologists in selected level III hospitals in Davao City on laboratory quality assurance in terms of socio-economic status such as educational attainment, and annual income, employee position, and length of practice.

C. Statement of the Problem

The study assessed the knowledge, attitudes, and practices of medical technologists on laboratory quality assurance programs in selected level III hospitals in Davao City with a survey questionnaire and determined the sociodemographic factors affecting their practices of laboratory quality assurance. Generally, the researchers sought to answer the question: *"What are the knowledge level, attitudes, and practices of medical technologists in selected level III hospitals in Davao City towards laboratory quality assurance?"* Specifically:

- What is the perception of the medical technologists in selected level III hospitals in Davao City on laboratory quality assurance in terms of knowledge, attitude, and practice?
- What are the main perceived impediments among the medical technologists in selected level III hospitals in Davao City affecting the practices of laboratory quality assurance?
- How do the following sociodemographic factors correlate with the practices of medical technologists in selected level III hospitals in Davao City on laboratory quality assurance in terms of socio-economic status such as educational attainment and annual income, employee position, and length of practice?

D. Hypothesis of the Study

H_0: Education, income, employee position, and length of practice do not have a significant effect on the practice of quality assurance among medical technologists in selected level III hospitals in Davao City.

E. Scope and Limitations of the Study

This study primarily focused on assessing the knowledge, attitude, and practices on laboratory quality assurance among medical technologists in selected level III hospitals in Davao City. In this study, knowledge was limited to the book-based concepts of quality assurance situations inside the laboratory, which was assessed through a survey questionnaire. In terms of attitude, the study covered the perceptions of medical technologists regarding the benefits and significance of quality assurance measured through the Likert scale and determined the common barriers to quality assurance. The practice was delimited to questions that ask about factual circumstances that measure behavioral patterns of respondents through the Likert scale. Respondents in this study came from laboratories in selected level III hospitals and are exclusively operating solely within the vicinity of Davao City. The medical technologists involved in the study have at least a bachelor's degree and are currently working in Brokenshire Hospital and Southern Philippines Medical Center.

The findings of this study had to be seen in the light of some limitations. One of which is the sample selection chosen, which was obtained with a non-probability, convenience sampling method. The researchers in the data gathering utilized a survey questionnaire. The researchers chose this method to consider particular factors such as the limited dissemination of

questionnaires and access to the respondents due to the restrictions imposed by the government as a protective measure during the ongoing COVID-19 pandemic. Although this allowed a more convenient sampling, it did not ensure some degree of representativeness of all the strata in the population. It is recommended that future researchers with the same objectives conduct their study during a period without restrictions such as community quarantine. Eliminating such hindrance would allow for an unrestrained selection between all applicable sampling methods, indicating a more representative sample of the population.

F. Significance of the Study

The findings of this research will be significant in the assessment of the level of knowledge, attitude, and practices of medical technologists on laboratory quality assurance in selected level III hospitals in Davao City. This research will contribute significantly to the benefit of the following:

To the Medical Laboratory:
The findings of this research will redound to the benefit of the laboratory in evaluating the level of knowledge, attitude, and practices of their workers, which will enrich their knowledge and understanding of their product or service. The information gathered from this study will be vital in identifying problems affecting quality assurance in the laboratory, which may lead to better strategies and programs geared towards improving human resource management.

To Medical Technologists:
The findings of this research will be significant in motivating medical technologists by evaluating their performance, which may lead to effective learning and training, promoting good working practices.

To Patients:
Considering the assessment of medical technologists will give suggestions on how to improve the laboratory service. This will ensure that laboratory product or service is up to standards and patients consistently receive high-quality service.

To Future Researchers:
Data collected from this research may be used as reference data in conducting new research or in testing the validity of other related findings. This may serve as a cross-reference for future research which could provide background or an overview of medical technologists' knowledge, attitude, and practices regarding quality assurance.

G. Definition of Terms

Analytical Phase: The phase involving the actual laboratory test in which samples are analyzed using chemical reagents and/or automated instruments.

Attitude: It refers to a person's actions and behavior towards someone or something and the feelings and thoughts that drive their behavior. The attitude of medical technologists in this study will be identified by their views on how beneficial or significant quality assurance is in the medical laboratory and the perceived impediments they are aware of.

Department of Health (DOH): The national health government agency of the Philippines.

Education: The highest education level attained by the respondents.

Income: The annual income of the respondents.

Knowledge: It refers to the degree to which a person is familiar and competent in a specific topic. This study defines knowledge as the medical technologists' perceptions towards general laboratory quality assurance principles. Knowledge was measured through the subjects' agreeableness towards statements about laboratory quality assurance.

Laboratory: A medical facility where clinical tests are performed. This study focuses on medical technologists working in laboratories in level III hospitals in Davao City.

Level III Hospitals: Hospitals that have gained the highest level based on service capability, offering a wide range of specialized clinical and ancillary services as well as medical specialty and/or subspecialty training programs. Hospitals are classified by the DOH in reference to Administrative Order (A.O.) 2012-0012-A. A complete list of services provided by different hospital levels is in Appendix C.

*Medical Technologists***:** Health professionals who use analytical methods and instruments and apply scientific principles to aid in the diagnosis of disease. In this study, they refer to medical technologists with at least a bachelor's degree in medical technology or a related field currently working in level III hospitals in Davao City.

*Practice***:** The inclination of a person to follow and comply with procedures. In this study, practice refers to the frequency at

which medical technologists in Davao City perform specific laboratory quality assurance procedures.

Preanalytical phase: This phase covers the procedures done before the test is performed. It includes, but is not limited to, test requisition, patient preparation and specimen collection, specimen accessioning, specimen transport, and specimen processing.

Post-analytical phase: The last phase of laboratory testing where results are recorded, evaluated for quality control, interpreted, and released to the patient or physician.

Quality assurance: A part of quality management which consists of procedures and programs implemented to provide confidence that quality standards can be fulfilled (ISO 9000). Quality control and quality improvement initiatives are included under quality assurance. This study's scope only includes quality assurance in a medical laboratory that is commonly practiced across all sections.

Sociodemographic factors: Describe populations or groups based on a combination of personal, social and economic measures. Education, income, job position, and length of practice are indices to be used in identifying the respondents' sociodemographic status.
World Health Organization (WHO): The global health agency of the United Nations.

II. LITERATURE

A. Review of Related Literature

Quality assurance, as defined by the International Organization for Standardization 9000:2015, is a component of quality management aimed at building confidence that quality requirements can be fulfilled (International Organization for Standardization [ISO], 2015, as cited in American Society for Quality [ASQ], n.d.). Hoyle (2001) likens quality assurance managers as "Corporate Quality Control" (p. 60), whose role is to oversee the quality of an entire organization rather than a single product.

What constitutes quality assurance varies on the organization or regulatory body. According to the Clinical Laboratory Improvement Amendments (n.d., as cited in the American Academy of Family Physicians [AAFP], n.d.), a quality assurance program in a laboratory must fulfill ten standards, which cover staff management, quality control of test results, and documentation. On the other hand, the World Health Organization (WHO, n.d.) sections quality assurance into four parts: documentation, standard operating procedures (SOPs), use of quality control, and an external quality assessment scheme (EQAS). Under relevant Philippine law (Administrative Order 2007-0027 and Department Memorandum No. 2009-0086-B), licensed laboratories should possess an internal laboratory assurance program and participate in an External Quality Assessment Scheme (EQAS) (Duque, 2007; Lutero, 2014). In any case, to achieve quality assurance in a medical laboratory, medical technologists must possess adequate knowledge, have the appropriate attitudes and practice standards outlined by professional accreditors and government agencies.

Knowledge of Medical Technologists on Laboratory Quality Assurance:

Knowledge and awareness are two vital domains to attaining quality assurance. Medical technologists must familiarize themselves with the different quality processes practiced in the laboratory and possess the required competencies and skills (Hussain, Abba, & Leleu-Merviel, 2006; Blumen, Naud, Palumbo, McIntosh, & Wilcke, 2010). Moreover, ISO standards, including ISO 9001, ISO 15189, and ISO 17025, advise laboratories to provide documentation on staff training and performance (Valdivieso-Gómez & Aguilar-Quesada, 2018). Highlighting the importance of quality awareness is a case study involving an automobile factory. By providing on-the-job training and education to all workers and reorienting them to the company's quality culture, the factory performed better quality checks (Hussain et al., 2006). In the context of laboratory testing, Manickam and Ankanagari (2015) argued that evidence-based training improves awareness and competence among medical technologists on quality assurance.

Several studies assessed the knowledge of laboratory quality assurance and its components among laboratory staff, and knowledge levels have varied between locales and periods. Knowledge levels among medical technologists in Vermont, United States were high, as 85% concurred that staff was oriented in quality assurance guidelines (Blumen et al., 2010). In Lahore, Pakistan, 76% of medical laboratory technologists had average knowledge of quality control, and 10% possessed good knowledge (Azhar, Mumtaz, Ibrahim, Butt, & Qureshi,

2011). Nonetheless, roughly three-quarters of the respondents felt that the medical technology curriculum was insufficient in preparing them for quality assurance/control responsibilities, reinforcing the need for integrating quality assurance in the bachelor's program. High levels of knowledge were also reported in Addis Ababa, Ethiopia, where 81.7% of 175 participants in 30 hospitals had better knowledge of in-house internal quality control (Dereje Mamuye, Yamirot Merga, Kumera Terfa, Fatuma, & Aster, 2018).

Refuting the first cluster of studies are Senthilkumaran, Synthia, and Sundhararajan (2014), who described biochemical lab technicians in a tertiary care hospital in Chennai, India as having a "lapse in basic knowledge of external quality assurance" (para. 16) (although their knowledge improved following a training program). Theodorakioglou and Tsiotras (2000) also uncovered the same issue, in which two-thirds of managers in Greek hospitals were unfamiliar with ISO certification, and 91.7% had not heard about internal personnel working within the organization and seek help from their managers or colleagues to fulfill their responsibilities.

While the studies mentioned above measured the knowledge of laboratory quality assurance of medical technologists, any interpretation must be made carefully considering their methodologies and data. For instance, in the Vermont study, the response rate was 50%, below the 60% figure recommended by Fincham (2008). Meanwhile, Dereje Mamuye et al. (2018) pursued a non-probability convenience sampling method. The study of Senthilkumaran et al. (2014) only included ten laboratory technicians, which did not align with the recommended sample size of 50 respondents for causal-comparative studies (Borg and Gall, as cite in Delice, 2008). Also, how the knowledge scores were calculated was not mentioned.

Significance of Quality Assurance in the Laboratory:

The phases of the laboratory, from preanalytical, analytical to post-analytical phases, which involve the identification of patients, ordering of the tests, collection of specimens, testing, transportation, and other procedures, are all prone to errors. These errors may affect the latter in the patient diagnosis and patient management since 60 to 70 percent of test results are used to make these decisions. Quality assurance is a management strategy; it involves identifying errors happening inside the laboratory and how to plan and prevent these errors (Agarwal, 2014).

Without the proper plan and quality assurance, there may be several negative results of laboratory error, such as wasted resources, patient care not administered adequately and appropriately, outbreaks, injuries, and even death (WHO, 2011).

To decrease errors in the laboratory phases and to meet satisfactory results, the quality assurance has three activities: first would be the activities to prevent the errors before they even occur inside the laboratory through the selection of the appropriate method with both high accuracy and precision, maintaining the equipment, use of standard operating procedures, hiring skilled personnel and having organized laboratory designs; second would be activities to be assessed and maintained during the processes by the quality control system, inspecting the functions of the instrument and by engaging in the external Q.A. projects; and lastly, correcting errors after performing activities by troubleshooting the machine or instrument that made the error, double-checking the work done and by timely communication with the professional who handled the instrument (Mekonnen, 2004). According to Plebani (2009), some initiatives to reduce errors in the laboratory include the implementation of an external quality assurance program wherein laboratories should evaluate and compare the results and performances in which it may be able to monitor the error rates and run through the objectives and see how the performance is, which would also encourage the laboratory professionals to perform better in the laboratory activities.

In line with reducing laboratory errors, the cost of quality refers to the difference between the current laboratory expenses in providing services and the laboratory expenses incurred without making any errors. In the study conducted by Schmidt and Pearson (2019), estimating the cost of quality of errors during the analytical phase was done. It shows that analytical errors are potential sources of risk and cost. Each analytical error depends on the magnitude and level of error. Also, the cost includes failures in testing, repeat testing, lawsuits, and harm caused to patients. The estimated cost of error could be calculated by measuring the average cost of each patient's result and the overall distribution of patient results.

Quality assurance in the laboratory service involves the entire testing process (AAFP, n.d.). As part of improving and providing quality laboratory service, monitoring customers' level of satisfaction is an essential indicator of quality management. The laboratory must employ tools that would actively seek information from customers. This advanced tool is used in obtaining information regarding complaint monitoring, satisfaction surveys, internal audit, and management reviews (WHO, 2011). A study conducted in Ethiopian Public Hospitals showed that patient satisfaction with laboratory service is generally high. However, satisfaction decreases a significant number of patients due to gaps such as long waiting time, unjust fees, inadequate test menu, providing clear and understandable information during the collection of specimens, providing information regarding laboratory results, courtesy and competency of laboratory professionals, and loss of laboratory results (Hailu et al., 2020).

Medical technologists play a significant role in quality systems inside the laboratory. A study by Blumen et al. (2010) focuses on the knowledge and perceptions of medical laboratorians including medical technologists and medical laboratory technicians in Vermont. Results from the study showed that medical laboratorians were knowledgeable and familiar with quality assurance in the laboratory but differed on how they view quality in the laboratory. These medical laboratorians play a crucial role in quality control and quality assurance which is critical for patient testing and results. However, in a study conducted in selected health care centers in Addis Ababa, Ethiopia, having better knowledge and attitude does not always lead to good quality control practice inside the laboratory (Dereje Memuye et al., 2018).

*Impediments to the Implementation of Quality Assurance in Laboratories**:***

*On Barriers that Impedes the Implementation of Quality Assurance Programs**.*** Implementation of quality assurance is a meticulous process that needs to be accomplished for an extensive duration. It requires an in-depth understanding and deliberation of the salient elements needed to execute an effective one, including the impediments to its implementation. An article on the "barriers limiting the implementation of quality assurance programs" from Health Services Research, Luke and Boss (2017) reiterated from the works of Codman that there are three major barriers to the implementation of quality assurance programs in health institutions. First is the *conceptual barrier* to the satisfactory definition of quality which also includes what constitutes it. Though there is no definitive answer to this question, various answers motivate the discourse about it. The next barrier is the *measurement of quality*, answering the dilemma whether it is a measure of process or measure of outcome.

Most importantly and considered as the ultimate barrier is the *assessment of the quality of care*. It also includes selecting assessment strategies such as the Quality Assurance Monitor, Health Accounting, the Tracer method, the Bicycle method, etc. Strategies for quality assurance are still unclear and will depend on different factors such as its purpose, the level and type of care provided, and the resources. Based on these major barriers, Luke and Boss (2017) recommended that future researchers of similar subjects focus on the said barriers. Hence, they were able to draw ten barriers to change in health institutions. These include the following:

- Health professionals' autonomy expectations. Health professionals essentially expect that they have autonomy since they deal with critical decisions involving knowledge and practice-based skills in diagnosis and treatment. For this reason, health professionals are traditionally regarded to have high levels of functional independence. This autonomy minimizes their observation of their work and establishes their resistance to implementing formal approaches to assure quality care. Hence, the cooperation and support of these health professionals are one of the major factors in implementing quality assurance.
- Collective benefits of stability. Regularities of behavior are established inside a health institution. Examples of these are the routines performed, standard operating procedures (SOP), way of communicating, and standardized behavior. Hence, these regularities are coined to be absolutely functional and essential, accounting for the barriers of change that quality assurance programs should tackle.
- Organized resistance to change. This happens when there are people that will be affected by the change brought about by quality assurance programs. Changes in quality assurance, specifically the organization structure of the professionals, means there will be a change in power, influence, or status of the health professionals. Also, changes in quality

assurance will compromise the quality of care provided. Therefore, protection of quality will be in question, and resistance to this change will occur. Agents of change usually take action with caution since it requires effort and commitment since an action for change brings psychological risks, which lead to embarrassment and loss of influence or even abuse of critics from a misinterpretation of the intentions of the change agents. These factors impede the changes in quality assurance.

- Regularities of behavior. This is programmed for the members of the institution. Programmed behavior does not necessarily have negative effects since it is needed for the health institution to function. But in other contexts, programmed behavior impedes innovation, hence, resists change. The reason for this is that desired behaviors become perceived expressions as personal or organizational preference.
- Loss of vision on the broad perspective of innovation and change. This happens when people involved in small tasks tend to lose the idea of how their activities relate to the organization's objective. Moreover, attempts to change will threaten these kinds of people and it will appear disruptive. This is brought about not by the incompetence or lack of intelligence but rather due to the concentrated perspective of the people to their specialized functions, making them lose the vision of the broader effects of innovation or change.
- Scarce resources. The motivation for change is there but reality says that there is a lack of resources for these changes to happen. This causes organizations and institutions to be incapable of change despite the call for changes in their quality assurance.
- Sunk costs or inconvertible investments. This barrier is experienced mostly by affluent health institutions or highly trained health professionals. When institutions are being bound by their nonconvertible assets, they tend to be stuck on their wealth, hence incapable of change.
- Official constraints accumulation on behavior. This is due to the constraints brought by regulations, internal policies, and regulations. Also, constraints may come from the result of "knowledge explosion" (p. 311) or reliance on health care specialists since they serve as custodians producing still more sets of specifications that govern the actions of the members.
- Constraints on behavior that are unofficial and unplanned. This will come from informal organizations that are composed of people of high status. They establish resistance or opposition to change despite being informal and unofficial.
- Agreements between organizations that put limitations on their members. Interorganizational understandings tend to prevent changes more than internal obstacles. It is recommended that in order to avoid inter-organizational misunderstandings, quality assurance programs must embody the interdependent aspects of system design.

Consequently, the article emphasizes that for these barriers to be solved, there should be a shift on topics to be researched like shifting away from the technical considerations of the analysis and acquisition of data and towards the behavioral aspects of the changes needed. In summary, the focus on quality assurance should not be whether these technical problems are to be overcome, but rather whether it is right to assume that giving people data will influence their behavior (Luke & Boss, 2017).

In a study by Mesfin, Taye, Belay, Ashenafi, and Girma (2017) on the "Factors Affecting Quality of Laboratory Services in Public and Private Health Facilities in Addis Ababa, Ethiopia", laboratory quality system in Ethiopia remains weak due to factors which need more attention in strengthening the capacity of it and the quality system per se. After a cross-sectional study, it yielded major factors that affect the quality of laboratory services. These are: (1) poor quality of human resource management, (2) provision of resources is poor, (2) weak management commitment, (3) communication system is ineffective, and (4) well-established management of the system is lacking. Consequently, reasons such as poor equipment management, incompetent staff, staff motivation are low, high workload and weak support of management are also part of the reason why there is a weak laboratory quality system in Ethiopia. Based on this study, one of the reasons why the quality assurance practices are poor in Addis Ababa includes incompetent laboratory professionals wherein they don't calibrate and perform maintenance on their equipment, low supplies of reagents, internal quality control are not conducted regularly and many professionals there do not participate on the external quality assessment.

In a similar study of Pakrash (2017) on the "Challenges towards quality improvement in medical laboratory service in Nepal," he presented that the status quo in Nepal dictates current challenges that hinder the improvement of medical laboratory services there. One big obstacle is the inclination of the medical sector to commercial business and monetary deals brought by privatization. This consequently led to an increasing self-interest motive of doctors resorting to bribery and corruption or ill practices and misconduct. Moreover, Pakrash (2017) enumerated in his findings that the impediments in the quality of medical laboratories in Nepal include conversion of service business to commercial business, cuts and commission system, unhealthy competition inside the institution, poor monitoring system, utilization of materials with low quality, incompetent manpower and loopholes from the policies in the government. This is followed by his recommendation to have regular quality assurance research, training, rules and regulations, and to have regular supervision with proper monitoring.

On Challenges Faced by an Analytical Laboratory. Inside the laboratory, quality control serves a vital purpose in maintaining safety and accuracy in laboratory preparations. According to Kupiec (2006), as practices inside the laboratory continue to evolve, quality control should evolve as well. Meaning it also promotes new challenges that the Q.C. laboratories will face. He presented two potential challenges in a general laboratory, which have their unique difficulties and appropriate solutions – analytical and communication challenges.

- *Analytical Challenges.* Challenges may range from comparative analysis lacking its reference standards to complex sample matrix causing complication in quantitative analysis. Some drugs do not have readily available appropriate reference standards. This yields complications inside the laboratory since most of the qualitative and quantitative results are derived from analysis of such reference standards; hence some pharmacies deliver bulk chemicals prior to Q.C. testing. Consequently, solubility possesses a challenge caused by some drugs. For example, some drugs require a multi-solvent system for the drug to be subjected to quantitation. Contents of the formula may cause potential interference by the active ingredient during analysis. On the other hand, matrices of the excipients of a sample may show potent drugs having slow-release formulations. As a solution, drug solubility may be maximized by utilizing suitable solvents having homogenization. The sensitivity of instruments may also present problems; hence, a thorough understanding of the capability of the laboratory is necessary.
- *Communication Challenges.* Communication plays a vital role in the exchange of information between facilities and people. Q.C. laboratories play a role in equipping pharmaceutical agents with information and results that are needed. Hence, laboratories must have as much information as possible regarding drug specification and formulation to ensure the quality and accuracy of information.

Quality control is an important part of quality management which is also under quality assurance, wherein it reduces errors by evaluating the analytical process. A study by Nnakenyi, Ugonabo, and Meka (2015) entitled "The challenges of implementing Quality Control in a manual African laboratory" tackles the problems encountered in implementing quality control in a manual laboratory in Africa. Quality control materials are usually run before shifts after calibration, maintenance of equipment, and change of reagent lots or when the results of a patient turn out inappropriate. But due to insufficient funds, infrastructure and amenities, African laboratories resort to manual processing. This leads to unavoidable errors requiring the need for quality control implementation but is regarded as an extra expense. In this study, the researchers run an analytical test with the use of freshly prepared reagents that were derived from published and validated methods. Next, spectrophotometers are used to detect optical density readings. Lastly, the quality system was reviewed to assess quality control materials, type, cost, frequency, and preservation facilities. The study arrived with a result of a limited consistency of quality control due to high levels of sample volume. Hence, no accuracy of quality material was available for external quality assessment. The manual analytical method requires a large sample volume which yields extra cost, especially in a resource-limited laboratory setting. It is then recommended to adopt other methods with smaller sample volumes to maximize the quality control materials.

Compliance of Medical Technologists and Medical Laboratories towards routine quality assurance:

Every country follows a particular quality assurance program that differs in terms of the organization or agency that

administers its assessment. One of the most adapted accreditation is the International Organization for Standardization (ISO) 15189:2012 '*Medical laboratories - Particular requirements for quality and competence*.' It aims to standardize medical laboratories to develop appropriate internal quality management systems and assessment. According to Horvath, Watine, and Miko (2005), accreditations based on both standards and evidence-based laboratory management are practical tools that could initiate cycles of improvement by a continuous process of questioning and reviewing current practices. It paves the way for the identification of deficiencies in both knowledge and skills of the laboratory professionals and quality control of the tests to be conducted.

In light of this, Dereje Mamuye et al. (2018) stated that most of the laboratory professionals who participated in their study showed better knowledge in the preparation of in-house-made Internal Quality Control (IQC). When asked about the contributing factors to the hindrances to attaining a good IQC, the most challenging component is the expensiveness of materials, followed by their heavy workload and then the difficulty of preparing such controls. Moreover, participants from SLIPTA (Stepwise Laboratory Improvement Process Towards Accreditation)-accredited laboratories are shown to have better knowledge compared to those who work at laboratories without the said accreditation.

In the Philippines, there is a systematic approach to the nationwide external quality assessment program. Conforming to the Administrative Order No. 2007-0027, it is an obligatory step for a laboratory in the country to ensure strict compliance in having a quality assurance program by participating in the yearly conducted National External Quality Assessment Scheme (NEQAS) before they secure a license to operate. It ensures that there is a uniform standard throughout the country. This scheme consists of five institutions that were assigned as National Reference Laboratories (NRL) with their corresponding laboratory sections to assess.

A related study conducted by Galit et al. (2019) indicates that in all regions of the Philippines, there is an increase in laboratory participants in 2015 compared to that of 2014. The spike in the number of participating laboratories is prominent in certain regions like NCR, Region II, Region IV-A, Region VII, and Region IX. However, despite the increase in participants, the majority still performed poorly in the NEQAS for Diagnostic Medical Parasitology. In contrast to the previous study, Mondoy et al. (2017) stated in their findings that there is an evident overall improvement in the performance of participating clinical laboratories in bacteriology with an increased number of participants that were able to obtain passing scores.

According to Dereje Mamuye et al. (2018), the sociodemographic characteristics of respondents affect the practice of quality control among medical laboratory professionals. Findings from the study indicate that work experience and educational attainment were found significantly associated with quality control. Medical laboratory professionals with longer working experience perform better practices. Association between educational attainment and quality control practices showed that individuals with a degree and postgraduate education perform better than diploma graduates. Also, individuals involved in Stepwise Laboratory Improvement Process Toward Accreditation (SLIPTA) have better working practice than those who do not participate in SLIPTA.

Other sociodemographic factors such as age and sex have a significant association with quality control knowledge. Participants aged 30 and above have better knowledge than those of younger age. Also, males are more knowledgeable than females in terms of quality control. In another article that has notable likeness conducted by Blumen et al. (2010), respondents with higher credentials, long years of professional experience and a superior job title agree to higher quality assurance standards.

Synthesis:

Quality assurance (Q.A.) ensures that the practices done by medical technologists inside the laboratories are executed with utmost efficiency and proper management based on the ISO standards (ASQ, n.d.) to refrain from effectuating erroneous performance in the preanalytical, analytical, and post-analytical phases of laboratory testing and to deliver a quality service a patient needs to receive accurately. In providing such quality in a laboratory, competency both in staff performance and processing of reliable results is a requirement; this does not only foreground the significance of quality assurance but also accords an entire organizational knowledge with regards to the implementation of evidence-based training to further enhance the medical technologists' comprehension about the technicalities of quality, as well as their proficiency and expertise. Several studies conducted in Vermont, United States;

Lahore, Pakistan; and Addis Ababa, Ethiopia showed statistics of high levels of knowledge among medical laboratory technologists, wherein more than half of their respondents garnered a range from "average" to "better" knowledge of internal quality control which is an indicative measure for reinforcement of fully implemented quality assurance.

In the phases of laboratory testing, critical decision-making is necessary to avoid unfortunate incidents from transpiring as it is considered to be a process most prone to miscalculation and inaccuracy which may directly influence both the management and diagnosis of a patient; thus, quality assurance is essential to prevent the occurrence of these errors (Agrawal, 2014). Q.A. incorporates the use of instruments that aid in monitoring the performance of a laboratory, in which complaint monitoring, satisfaction surveys, internal audit, and management reviews are evaluated to identify the possible risk and cost references, as well as to acquire different causes of analytical errors based on their intensity and level of error. In eradicating inadequate service and unsatisfactory evaluations from patients, medical technologists fulfill the most pivotal role in the development of quality control and assurance; contrarily, being knowledgeable and possessing a better attitude do not necessarily equate to putting quality assurance into good practice inside the laboratory as mentioned in the Addis Ababa study (Dereje Memuye et al., 2018).

Contributions to the impediments of Q.A. implementations are determined through a conceptual impedance, measurement of process and outcome, and the assessment of the quality care delivered. These barriers are dependable on factors particularly, its purpose, resources, or the type of care given, therefore, still considered equivocal. Several aspects which disrupt Q.A. implementation involve the health personnel's intransigence and excessive autonomous actions, incompetency in manpower, incapability to adapt toward changes and innovation, monetary commissions brought by privatization, the inadequacy of the facility in supplies and resources, and lack of interdependent systematic design that enables standardization of management in laboratory practices – in dealing with the mentioned impediments, behavioral changes of the medical technologists concerning the application of quality assurance in the laboratory setting should be the focal point, rather than emphasizing solely on the technicalities (Luke & Boss, 2017). Quality control (Q.C.), on the other hand, is a subprocess of Q.A. designed to assess the quality of laboratory management, mainly functions as product-oriented and also contributes an immense influence in reducing analytical errors in facilities that resorted to manual analytical methodologies due to insufficient funding, and problems with maintenance of equipment and amenities, or the lack thereof.

One of the qualification protocols needed to attain a laboratory license is its accreditation based on specific standards of the agency assigned to administer the assessment tool. Being able to distinguish the flaw in a system of laboratory management of both practice and comprehension of laboratory personnel aids in the commencement of improving quality assurance and control. Among the laboratory technologist respondents of the studies by Dereje Mamuye et al. (2018) and Blumen et al. (2010), the rates of compliance towards quality assurance among medical technologists and medical laboratories are affected by sociodemographic factors in such a way that work experience and educational attainment are directly proportional to a better quality control practices, whereas sex and age demographic profiles of the laboratory technologists who participated in the study exhibited a result where ages 30 and above, and males are more knowledgeable.

Although the referenced research provided a wide array of information regarding quality assurance, their limitations must still be taken into account. Particular exemplifications of this are response rates below the recommended average standard in the study of Blumen et al. (2010), the sampling methods used in the Addis Ababa Ethiopia study which may yield a biased result, the insubstantial sample size in Senthilkumaran et al. (2014) research, and indeterminate calculations of scores by those as mentioned above. In addressing these impediments, the researchers will be more knowledgeable in amending the preferred methodologies to avoid the recurrence of erroneousness to conduct the research more constructively.

B. Theoretical study

Individuals with better education are considered to transpire more mindful responses to natural issues and therefore, act responsibly in a self-aware way. The behavioral change theory is a simple linear model which gives a base to the thought of a conceivable relationship existing between knowledge, awareness, and attitude, and how it can produce an effective action (Akintunde, 2017). This study is anchored in the mentioned theory as the medical technologists and professionals who are more knowledgeable and attained a higher educational level tend to practice quality assurance

better in the laboratory setting according to a research conducted by Blumen et al. (2010). However, decent information on natural factors may not necessarily suggest great conduct, and the absence of knowledge and awareness may likewise not infer a poor performance. Accordingly, other mediating factors such as the locus of control, the motivation to act, and moral obligation should be considered. While a line of conceivable relationship can be interpreted through this model, the truth is definitely more unpredictable than this straight pattern, consequently, a further developed model fusing this line of relationship is expected to offer a concise clarification of the cooperating factors of human behavior in practice. Another theory associated with the study is the planned behavior theory proposed by Azjen (2002); this model involves further clarifications of the association between knowledge, attitude, and behavioral expectation as they impact the actual implementation. Nonetheless, knowledge is certifiably not a particular segment in the model but rather referred to as *"attitudes are an element of beliefs*," since beliefs allude to knowledge regarding a particular behavior in this concept. For instance, when an individual comprehends that he/she has command over a specific circumstance, his/her social aims mirror this understanding as much as his/her convictions concerning the result of a specific behavior. Relating to the concept, medical professionals who are in control based on factors like their employee position or length of practice may reflect their understanding of quality assurance through their attitude and behavior toward their practice (Dereje Mamuye et al., 2018). With sufficient knowledge and optimal awareness and attitudes applied by medical technologists in their performance, their compliance toward quality management and protocols are also positively impacted and enhanced, thus contributing a significant effect on the practice of quality assurance inside the laboratories.

C. Conceptual Framework

The researchers utilized an input-process-output (IPO) model to describe the conceptual framework in this study (Figure 1). The input variable consisted of two major components: the demographic information of the respondents and the knowledge, attitude, and practices (KAP) on the quality assurance of medical technologists in the laboratory. The first component was composed of the name (optional), age, and biological sex of the respondents; laboratory assigned; annual income; educational attainment; length of practice; position in charge; and laboratory section assigned. The second component included the knowledge of medical technologists on quality assurance in the laboratory, their attitude towards the quality assurance and impediments affecting the quality assurance in the laboratory, and their practices inside the laboratory.

A KAP survey questionnaire and the statistical treatment constituted the research process in this study. Consequently, the research findings, conclusions, summary, and recommendations were the foundation for the assessment of the knowledge, attitude, and practices on laboratory quality assurance among medical technologists in selected level III hospitals in Davao City.

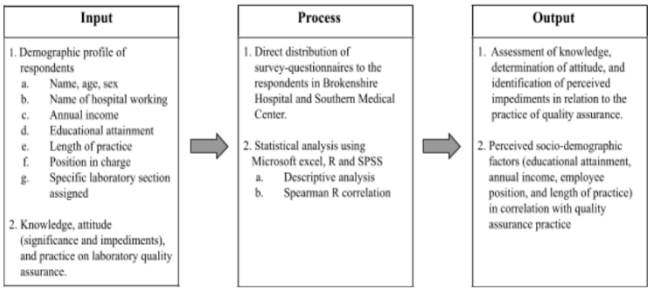

Fig.1. Input-Process-Output diagram on the Assessment of KAP on Quality Assurance among Medical Technologists in Davao City.

III. RESEARCH METHODS

A. Research Design

The study design utilized descriptive quantitative study and inferential statistical research tools. It examined the knowledge, attitudes, and practices of medical technologists in Davao City concerning quality assurance inside the laboratory. This allowed a deeper analysis and further emphasis on how factors such as the comprehension, attitude, sociodemographic profiles of medical technologists, as well as the impediments, influenced the quality assurance in the laboratory. Through this, the researchers were able to recognize matters or issues relating to practices of quality assurance that need to be emphasized for their enhancement. With a quantitative approach, the collated data were validated, and it aided in proving or disproving previously collected data from other studies.

Since the study aimed to gather information on the target population through data analysis, it prompted the researchers to make use of the descriptive research design. Moreover, the use of inferential statistical models allowed the researchers to

correlate the sociodemographic profiles of the populace to the sample data, as well as other statistical methods presented in previous researches. The researchers collected the data that provided an account or description of the chosen population through questionnaires using the survey method. The questionnaires mainly consisted of closed-ended questions particularly focused on delving the knowledge, attitude, and practices of quality assurance, with the use of a 5-point Likert scale, from 1 being the lowest and 5 being the highest, based on the quantitative research variables that form the data gathering basis for a research design which enabled the researchers to explore an in-depth contextualization of the research questions.

B. Subjects and Study Site

Since the study aimed to gather information on the target population through data analysis, it prompted the researchers to make use of the descriptive research design. Moreover, the use of inferential statistical models allowed the researchers to correlate the sociodemographic profiles of the populace to the sample data, as well as other statistical methods presented in previous researches. The researchers collected the data that provided an account or description of the chosen population through questionnaires using the survey method. The questionnaires mainly consist of closed-ended questions particularly focused on delving the knowledge, attitude, and practices of quality assurance, with the use of a 5-point Likert scale, from 1 being the lowest and 5 being the highest, based on the quantitative research variables that form the data gathering basis for a research design, enabling the researchers to explore an in-depth contextualization of the research questions.

The total number of medical technologists in all the level III hospitals found in Davao City was 355 ("List of Accredited Level 3 Hospitals", 2020). Subjects of this study were medical technologists who have at least a bachelor's degree and are currently working in the two selected hospitals, namely, Brokenshire Hospital and SPMC with a total population of 239 Medical Technologists employed in these institutions. Moreover, the total number of respondents that were given consent forms were 150. Out of this, there were 117 respondents who agreed to participate in the study and were given survey questionnaires directly.

C. Data Measure or Instrumentation

The instrument used was a researcher-made questionnaire to gather the needed data for the study. The questionnaire was derived from the researcher's readings, previous studies, and published related studies. It was divided into two sections. The first part consisted of items gathering the respondents' demographic information such as name, age, biological sex, name of hospital or laboratory they were currently working at, annual income, educational attainment, length of practice, laboratory position, and laboratory section assigned. The second part was the questionnaire proper, subdivided into four categories: knowledge on quality assurance in the laboratory, attitudes towards quality assurance in the laboratory, attitude towards impediments affecting quality assurance in the laboratory, and practices of medical technologists inside the laboratory. The questionnaire consisted of a total of 50 items. The items included a five-point Likert scale measuring agreement and frequency. A space for comments was provided to accommodate free formatted views related to the research instrument and the topic.

There were 32 respondents who underwent pilot testing to test the validity of the questionnaire. It was validated using Cronbach Alpha through the Statistical Package for the Social Sciences Software (SPSS Software). This measured the scale reliability of the questionnaire. A score of 0.79 was obtained and was accepted based on the score range of 0.70 or higher as acceptable. Respondents involved in the pilot testing were excluded from the main respondents after the validation was done.

Moreover, all data were monitored and reviewed by researchers to check the accuracy and completeness of all questionnaires.

D. Data Gathering Procedure

The study involved medical technologists who were currently working in Brokenshire Hospital and Southern Philippines Medical Center in Davao City. The researchers sent a letter to Ms. Zenaida M. Banzon, the Chief Medical Technologist of Southern Philippines Medical Center, and Ms. Ruby Morga, the Chief Medical Technologist of Alexian Brothers Health and Wellness, to ask for the total number of medical technologists per institution mentioned in Davao City to get the total population size. The desired number of respondents or the sample size was formulated out of the population size.

After getting the desired number of respondents, consent forms were handed out to them in order to present the researchers' intentions and their approval to participate in this study. Hence, the total number of respondents depended on the number of medical technologists who gave their consent to participate in this study. The respondent's participation was considered voluntary and confidential, and questionnaires were directly disseminated to the respondents. Data gathered from the respondents were encoded manually in Microsoft Excel. This served as the basis for the results of this study. This underwent a process wherein the researchers organized and analyzed the data and applied statistical treatment or analysis to extract the desired results for data interpretation.

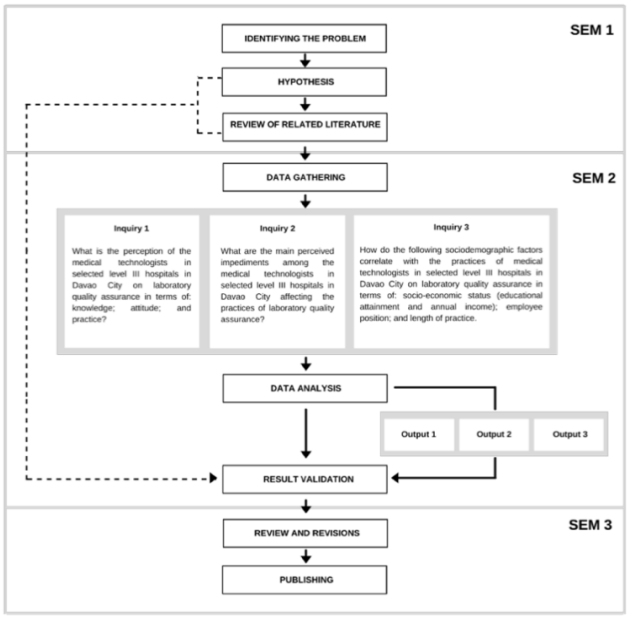

Fig.2. Workflow diagram of the study (A.Y. 2020-2021)

E. Ethical Considerations

Fundamental ethical considerations were based on principles such as informed consent, data privacy, and beneficence/non-maleficence. Ethical clearance and approval were obtained from the Faculty of Pharmacy Research Ethics Committee of the University of Santo Tomas with an assigned study protocol code of FOP-REC-2021-01-040 on April 8, 2021. The researchers procured permission from the respective clinical laboratories prior to the initial data collection.

Since the participants had autonomy over their decisions, they had the right to decide whether they would partake in this research. Data collection was administered through direct dissemination of surveying tools that included an informed consent form before the survey questions. The research participants were then informed regarding the study's significance and their vital roles in contributing necessary information that may help in the assessment of the knowledge, attitude, and practices on laboratory quality assurance among medical technologists in selected level III hospitals in Davao City. It was also indicated that they could skip questions they refuse to answer fully or partly. Completion of the survey questionnaire was indicative that they gave consent to participate in the study.

F. Data Analysis

Responses were uploaded and interpreted on Microsoft Excel, R, and SPSS. Sociodemographic data, as well as data outlining the medical technologists' knowledge, attitude, and practices towards laboratory quality assurance, were summarized through frequency counts and percentages. Spearman Rank was used for analyzing relationships between two ordinal variables; hence, this was used to correlate the sociodemographic factors with the practice of quality assurance. The level of correlation (rounded to two decimal places) was analyzed and interpreted based on the literature of Evans (1995) and is shown in Table 2. Any relationship was significant if the p-value was less than 0.05 ($p<0.05$).

Table.2. Range of Correlation Coefficient Values and the Level of Correlation

Range of Correlation Coefficient Values	Level of Correlation	Range of Correlation Coefficient Values	Level of Correlation
0.80 to 1.00	Very Strong Positive	-1.00 to -0.80	Very Strong Negative
0.60 to 0.79	Strong Positive	-0.79 to -0.60	Strong Negative
0.40 to 0.59	Moderate Positive	-0.59 to -0.40	Moderate Negative
0.20 to 0.39	Weak Positive	-0.39 to -0.20	Weak Negative
0.00 to 0.19	Very Weak Positive	-0.19 to -0.01	Very Weak Negative

Note. From Evans (1995)

IV. Presentation, Analysis, And Interpretation Of Data

A. Demographic Profile

The demographic profile of 117 respondents includes their age, biological sex, hospital affiliation, annual income, educational attainment, length of practice, position in charge, and laboratory section assigned (See Table 4).

Table.3. Respondents' Demographic Profile (n = 117)

Variable	Count	Percent (%)
Age		
Under 20 years	0	0.00
20-29 years	84	71.80
30-39 years	19	16.20
40-49 years	5	4.30
50-59 years	6	5.10
60-69 years	2	1.70
Above 70 years	0	0.00
No Response	1	0.90
Biological Sex		
Female	86	73.50
Male	28	23.90
No Response	3	2.6
Hospital Affiliation		
Brokenshire Hospital	32	27.40
Southern Philippines Medical Center	85	72.60
Annual Income		
Php 100,000.00 or less	7	6.00
Php 100,001.00 - Php 200,000.00	52	44.40
Php 200,001.00 - Php 300,000.00	25	21.40
Php 300,001.00 - Php 400,000.00	12	10.30
Php 400,001.00 - Php 500,000.00	10	8.50
Php 500,001 or more	7	6.00
No Response	4	3.40
Educational Attainment		
BSMT/BSMLS/BSPH	112	95.70
BSMT/BSMLS/BSPH with Master's Degree	5	4.30
Length of Practice		
Less than 2 years	17	14.50
2-4 years	38	32.50
5-7 years	27	23.10
8-10 years	7	6.00
More than 10 years	27	23.10
No Response	1	0.90

Table 3 shows the demographic profile of the respondents with 72.6% (n=85) respondents coming from the Southern Philippines Medical Center, and the remaining 27.4% (n=32) were from Brokenshire Hospital. Out of the total respondents, the majority (n=86) were female and most were in the 20 to 29 years age group (n=84) with a median age of 24.5 years of age. Moreover, 16.2% (n=19) of the respondents were 30 to 39 years of age, 4.3% (n=5) were 40 to 49 years of age, 5.1% (n=6) were 50-59 years of age, and the remaining 1.7% (n=2) were 60-69 years of age. Consequently, 95.7% (n=112) of the respondents had educational attainment of BSMT/BSMLS/BSPH and only 5 had a Master's Degree. The common annual income of respondents 44.4% (n=52) ranged from Php 100,001.00 to Php 200,000.00. Lastly, almost one-third (n=38) of the respondents had 2 to 4 years length of practice. This is followed by 23.1% (n=27) respondents with 5 to 7 years and 10 years of length of practice.

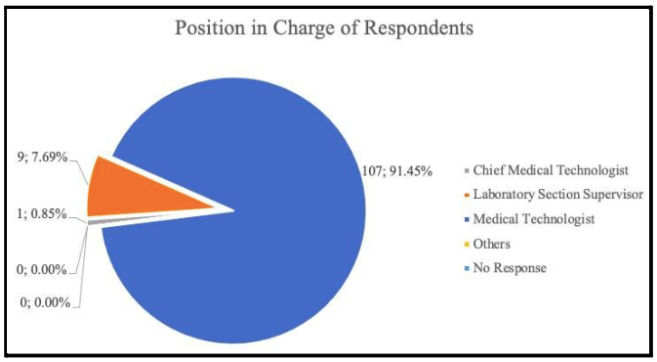

Fig.3. Position in Charge of Respondents in Percentages

In Figure 3, the respondents had different positions in charge in the laboratory, which included Chief Medical Technologist, Laboratory Section Supervisor or Head, Medical Technologists, and other specified positions depending on their laboratory section assigned. Among these the majority 92% (n=107), were Medical Technologists with varying levels of positions. This included Medical Technologist I, Medical Technologist II, Medical Technologist III, or Senior Medical Technologist, who were either a rotating staff or middle manager. Consequently, 7.69% (n=9) of the respondents were Laboratory Section Supervisor and a Chief Medical Technologist.

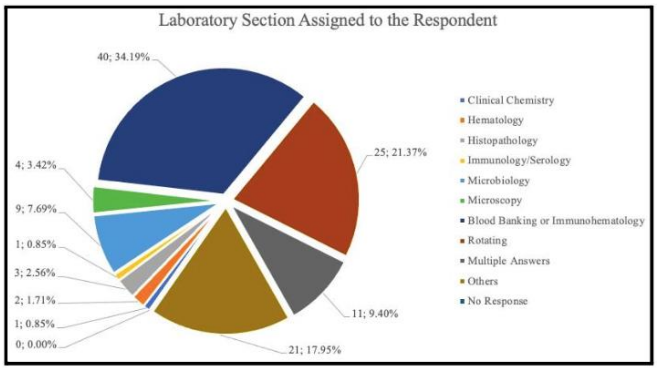

Fig.4. Laboratory Section Assigned to the Respondents in Percentages

The laboratory section assigned to the respondents in the laboratory is summarized in Figure 4. Most of the respondents (34.19%; *n*=40) were assigned in the Blood Banking or Immunohematology and this was followed by the Rotating Section with 21.37% (*n*=25) of the respondents. Consequently, 17.95% (*n*=21) of the respondents put "Others" as to where they were assigned, which included sections such as Phlebotomy, Quality Control, Generalist, IWNH/Newborn Screening, Drug Testing, HIV Laboratory, RHIVDA Confirmatory Laboratory, Blood Center, and Swabbing Pop-up Laboratory.

Moreover, eleven of the respondents were assigned to multiple sections such as Clinical Chemistry, Hematology, Immunology or Serology, Microbiology, Microscopy, and Rotating. On the other hand, some respondents were assigned to individual laboratory sections, such as 7.69% (*n*=9) in Microbiology, 3.42% (*n*=4) in Microscopy, 2.56% (*n*=3) in Histopathology, 1.71% (*n*=2) in Hematology, and 1.7% (*n*=2) in Clinical Chemistry and Immunology or Serology sections each.

B. Perceptions of Medical Technologists in Terms of KAP

Knowledge on Quality Assurance in the Laboratory:

Table.4. Knowledge on Quality Assurance in the Laboratory

Statement	Strongly disagree (%)	Disagree (%)	Neither agree nor disagree (%)	Agree (%)	Strongly agree (%)	No Response (%)
1.) Quality assurance involves the pre-analytical, analytical, and post-analytical phases of the laboratory.	0	0	0	6	93	1
2.) A sensitive test has a low false-negative rate.	3	3	4	34	53	3
3.) Accreditation is the goal of quality assurance.	9	3	15	26	45	1
4.) It is the responsibility of every medical technologist to attain quality assurance in the laboratory.	0	0	0	10	89	1
5.) A certificate of participation on an External Quality Assurance Program (EQAP) is a requirement for the renewal of the license of clinical laboratories under Philippine law.	3	0	1	20	76	0
6.) The standard deviation measures the accuracy of a laboratory test.	2	3	4	32	59	0
7.) Unknown samples under the External Quality Assurance Program (EQAP) are prepared by national reference laboratories.	0	3	1	18	79	0
8.) Specificity is a measure of a test's ability to detect positive cases.	17	7	6	32	38	0
9.) A urine specimen labeled with the patient's name "Pedro" is acceptable.	94	5	0	0	1	0
10.) The purpose of quality control materials (e.g. control samples) is to calibrate laboratory instruments.	20	18	5	19	38	0
11.) Voltage fluctuations in a laboratory instrument are a systematic and predictable error.	34	20	9	26	11	0
12.) Quality assurance helps medical technologists and the laboratory attain a more accurate and precise result.	0	0	1	15	84	0
13.) The World Health Organization (WHO) provides quality and testing standards to clinical laboratories.	21	2	11	21	44	0
14.) Quality control is a day-to-day activity.	0	0	2	13	85	0
15.) A test result is valid if one control value exceeds 3 standard deviations from the mean.	60	13	9	10	7	1

Findings in Table 4 summarize the responses from the respondents for each of the 15 statements. The statements in this portion of the questionnaire were related to knowledge on quality assurance in the laboratory. In each item, respondents were asked to rate their level of agreement along a five-point Likert scale.

Upon analyzing the data from 117 participants, 93% (*n*=109) of the respondents strongly agreed that quality assurance involves the preanalytical, analytical, and post-analytical phases of the laboratory, 6% (*n*=7) agreed on the same statement, while the remaining 1% (*n*=1) left the item unanswered. Among the respondents, 53% (*n*=62) strongly agreed that a sensitive test has a low false-negative rate. Thirty-four percent (*n*=40) agreed, while 4% (*n*=18) neither agree nor disagree, 3% (*n*-=4) and 3% (*n*=3) disagreed and strongly disagreed on the same statement, respectively. The remainder 3% (*n*=3) left the statement unanswered. With regards to the third statement, 45% (*n*=53) strongly agreed that accreditation is the goal of quality assurance, 26% (*n*=31) agreed, 15% (*n*=18) neither agree nor disagree, 3% (*n*=4) disagreed, and 9% (*n*=10) strongly disagreed on the same statement. The remaining 1% (*n*=1) left the statement with no response. The majority of the respondents (89%, *n*=104) strongly agreed that it is the responsibility of every medical technologist to attain quality

assurance in the laboratory, 10% (*n*=12) agreed, while 1% (*n*=1) left the aforementioned statement blank. Seventy-six percent (*n*=89) strongly agreed that a certificate of participation on an External Quality Assurance Program (EQAP) is a requirement for the renewal of the license of clinical laboratories under Philippine law, 20% (*n*=23) agreed and 3% (*n*=4) strongly disagreed, while 1% (*n*=1) was unsure. It was found that the majority (59%, *n*=69) strongly agreed that the standard deviation measures the accuracy of a laboratory test and 32% (*n*=37) agreed. Five individuals (4%) were unsure whether the standard deviation determines the accuracy of a test, while 4 (3%) and 2 (2%) respondents disagreed and strongly disagreed, respectively. Regarding the seventh statement, most respondents (79%, *n*=92) strongly agreed that the unknown samples under the External Quality Assurance Program (EQAP) are prepared by national reference laboratories. Eighteen percent of respondents (*n*=21) agreed on the same statement while 3% (*n*=3) disagreed. The remaining 1% (*n*=1) was unassertive.

Among the respondents, 32% (*n*=38) agreed while 38% (*n*=44) strongly agreed that specificity is a measure of a test's ability to detect positive cases. Seven percent (*n*=8) disagreed, while 17% (*n*=20) strongly disagreed on the same statement. The excess 6% or 7 individuals neither agree nor disagree. Findings revealed that 94% (*n*=110) strongly disagreed that a urine specimen labeled with the patient's name "Pedro" is acceptable, while 5% (*n*=6) agreed. Only 1% (*n*=1) strongly agreed. From the findings above, it was evident that there was a spread in the responses of the participants in the tenth statement. Thirty-eight percent (*n*=45) strongly agreed while 19% (*n*=22) agreed that the purpose of quality control materials (e.g. control samples) is to calibrate laboratory instruments. Twenty percent (*n*=23) strongly disagreed and 18% (*n*=21) disagreed on the abovementioned statement. The remaining 5% (*n*=6) neither agree nor disagree. Thirty-four percent (*n*=40) strongly disagreed that voltage fluctuations in a laboratory instrument are a systematic and predictable error. 20% (*n*=23) disagreed, while 26% (*n*=30) agreed and 11% strongly agreed (n=13) on the same statement. It is noteworthy to mention that 9% (*n*=11) of the participants were not sure. Regarding the twelfth statement, the majority (84%, *n*=98) of respondents strongly agreed while 15% (*n*=18) agreed that quality assurance helps medical technologists and the laboratory attain a more accurate and precise result. Only 1% (*n*=1) was unassertive. Forty-four percent (*n*=52) strongly agreed that the World Health Organization (WHO) provides quality and testing standards to clinical laboratories. Twenty-one percent (*n*=25) agreed on the same statement. The 21% (*n*=25) strongly disagreed that clinical laboratories were provided by the WHO with quality and testing standards. Only 2% (*n*=2) disagreed. Therefore, 11% (*n*=13) neither agree nor disagree with the aforementioned statement. Among the 117 participants, 85% (*n*=100) of individuals strongly agreed that quality control is a day-to-day activity, while 13% (*n*=15) respondents agreed. The excess 2% (*n*=2) were unsure. Lastly, 60% (*n*=70) strongly disagreed and 13% disagreed that a test result is valid if one control value exceeds 3 standard deviations from the mean. Seven percent (*n*=8) strongly agreed, while 10% (*n*=12) agreed on the same statement. Nine percent (*n*=11) of the participants were unsure if a test result is valid if a single control value exceeds the mean by 3 standard deviations. Therefore, 1% (*n*=1) of respondents left the statement unanswered.

Attitude towards the Significance of Quality Assurance in the Laboratory:

Table.5. Attitude towards the Significance of Quality Assurance in the Laboratory

Statement	Strongly disagree (%)	Disagree (%)	Neither agree nor disagree (%)	Agree (%)	Strongly agree (%)	No Response (%)
1.) Quality assurance reduces complaints from customers.	2	1	3	27	67	0
2.) Quality assurance ensures customer satisfaction and customer loyalty.	1	2	2	26	70	0
3.) Quality assurance prevents error at an early stage.	0	0	1	26	73	0
4.) Practicing quality standards ensures non-faulty and accurate results.	0	0	3	25	72	1
5.) Quality assurance results to efficient laboratory performance.	0	0	0	21	79	0
6.) The quality management system in the laboratory cultivates collaboration between workers.	0	0	3	25	73	0
7.) Quality management system encourages continuous improvement.	0	0	1	17	82	0
8.) Quality assurance encourages personal responsibility and willingness to maintain efforts.	0	3	1	29	68	0
9.) Quality management system cultivates professional growth, essentially an advantage to gain new skills and work experience.	0	0	3	21	76	0
10.) Quality management aids in increases quality of laboratory outputs.	1	1	2	24	73	0

Table 5 **r**epresents the attitude of medical technologists towards the significance of quality assurance in the laboratory. Among the respondents, 67% (*n*=78) strongly agreed and 27% (*n*=32)

agreed that quality assurance reduces complaints from customers. There were 2 (2%) participants who strongly disagreed and 1 (1%) participant who disagreed with the aforementioned statement. The remaining 3% (*n*=4) neither agree nor disagree that quality assurance reduces customer complaints. The majority of the respondents (70%, *n*=82) strongly agreed that quality assurance ensures customer satisfaction and customer loyalty. Twenty-six percent of respondents (*n*=30) agreed on the same statement, while 2% (*n*=2) and 1% (*n*=1) disagreed and strongly disagreed, respectively. Only 2% (*n*=2) was unassertive.

It was found that 73% (*n*=85) of the respondents strongly agreed that quality assurance prevents error at an early stage. Twenty-six percent (*n*=31) agreed and the excess 1% (*n*=1) neither agree nor disagree on the third statement. Most of the respondents (72%, *n*=84) strongly agreed that the practice of quality standards ensures non-faulty and accurate results while 25% (*n*=29) of respondents agreed. The 3% (*n*=3) of the sample population was unsure while the remaining 1% (*n*=1) left the statement blank. Seventy-nine percent (*n*=93) of the total respondents strongly agreed that quality assurance results in efficient laboratory performance, while the remaining 21% (*n*=24) agreed as well. Seventy-nine percent of the respondents (*n*=93) strongly agreed while 21% (*n*=24) agreed that the quality management system in the laboratory cultivates collaboration between workers. These findings reveal that medical technologists in the laboratory give credence that the implementation of the quality management system encourages the distribution of work among health professionals in the laboratory. Therefore, it cultivates teamwork and collaboration inside the laboratory. Ninety-six percent of the respondents (82%) strongly agreed that the quality management system encourages continuous improvement, and the other 17% (*n*=20) agreed; only one respondent answered neutrally to this. On statement 8, it was shown that 68% (*n*=79) strongly agreed, 29% (*n*=34) agreed, and 3% (*n*=3) disagreed that quality assurance encourages personal responsibility and willingness to maintain efforts. Moreover, 76% (*n*=89) of the respondents strongly agreed that a quality management system cultivates professional growth, essentially an advantage to gain new skills and work experience, while 29% (*n*=25) only agreed and 3% (*n*=3) stayed neutral. Among them, 73% (*n*=85) strongly agreed, and 24% (*n*=28) agreed that quality management aids increase the quality of laboratory outputs, while 2% (*n*=2) were neutral, and both strongly disagreed and disagreed were only 1% each (*n*=1).

Practices of Medical Technologists inside the Laboratory:

Table.6. Practices of Medical Technologists inside the Laboratory

Statement	Never (%)	Rarely (%)	Some-times (%)	Often (%)	Always (%)	No Response (%)
1.) How often does your laboratory practice quality assurance?	0	0	0	13	87	0
2.) How often do you comply with the rules and regulations regarding quality assurance?	0	0	0	13	87	0
3.) How often do you identify the patient properly before proceeding to specimen collection?	0	0	0	3	97	0
4.) How often are your reagents and dilutions readily prepared before the actual examination and testing?	0	0	1	15	84	1
5.) How often do you collect the specimen at the right container?	0	0	0	2	98	0
6.) How often do you use the right preservatives or anticoagulants for the specimen?	0	0	0	3	97	0
7.) How often do you store your specimen at the right storage conditions? (temperature)	0	0	0	6	94	0
8.) How often do you always take into consideration the TAT (turn around time)?	0	0	1	15	85	0
9.) How often does your specimen get contaminated due to error in the laboratory?	38	52	6	0	3	1
10.) How often do you repeat the test due to error in the machine?	3	55	24	9	9	1
11.) How often do you check if you have expired or contaminated reagents?	0	0	0	19	80	1
12.) How often do you have incorrect calculations?	41	52	3	3	0	1
13.) How often do you calibrate the machines?	0	1	9	25	60	5
14.) How often do you record and report the results attained?	0	0	0	5	94	1
15.) How often do you ensure that the tests results are interpreted correctly?	0	0	1	4	94	1

Medical technologists' compliance with quality assurance in the laboratory is summarized in Table 6. All 117 respondents practiced laboratory quality assurance, and all reported that their respective laboratories complied with quality assurance regulations often or always. Nearly all of the surveyed laboratory professionals practiced quality assurance activities at least often, including storing the specimen at the right conditions (100%, *n*=117), preparing the proper reagents and

dilutions before testing (98%, *n*=115), collecting the specimens at the right container (100%, *n*=117), identifying the patient before specimen collection (100%, *n*=117), choosing the appropriate preservatives and anticoagulants for each specimen (100%, *n*=117), and calibrating the machine (85%, *n*=99).

Additionally, often or always, nearly all medical technologists checked if they have expired or contaminated reagents (99%, *n*=116), recorded and reported the results attained (99%, *n*=116), and ensured that test results are interpreted correctly (98%, *n*=115). All respondents took into consideration the turnaround time often or always. Medical technologists committed errors rarely. Only 3% (*n*=3) made incorrect calculations and contaminated specimens often or always, and more than half of the respondents (58%, *n*=68) rarely or never repeated a lab test due to an error in the machine.

C. Attitude towards Impediments Affecting Quality Assurance in the Laboratory

Table.7. Attitude towards Impediments Affecting Quality Assurance in the Laboratory

Statement	Strongly disagree (%)	Disagree (%)	Neither agree nor disagree (%)	Agree (%)	Strongly agree (%)	No Response (%)
1.) Following quality standards is time-consuming.	25	20	20	29	7	0
2.) Maintenance of quality service and product in the laboratory is costly.	3	9	25	37	26	0
3.) Quality assurance does not prevent waste of resources when errors occur (repeat of tests, troubleshooting, etc.).	17	26	19	29	9	1
4.) Following quality standards is burdensome and laborious.	44	22	21	9	3	0
5.) Complying to quality management system requires more employees.	10	29	27	20	14	0
6.) Quality assurance build barriers between workers.	50	40	7	2	1	0
7.) Quality management system requires extra credentials, advance skills, and additional training.	11	13	18	39	19	0
8.) Proficiency in quality assurance practice is significantly affected by educational attainment.	12	30	25	26	8	0
9.) Proficiency in quality assurance practice is significantly affected by age and work experience.	17	28	21	21	12	0
10.) Proficiency in quality assurance is significantly affected by laboratory position or job position.	23	32	20	18	7	0

Displayed in Table 7 are the attitudes of medical technologists towards impediments affecting quality assurance in the laboratory using measures of percentages. Twenty-nine percent (*n*=34) of the respondents agreed that these impediments include following quality control being time-consuming, while 25% (*n*=29) strongly disagreed. In the regard that maintenance of quality service and product in the laboratory is costly, 37% (*n*=43) agreed, and only 3% (*n*=3) strongly disagreed. A total of 34 respondents (29%) agreed that quality assurance does not prevent waste of resources when errors occur, while the other 30 respondents (26%) disagreed.

Almost half of the respondents (44%, *n*=51) strongly disagreed that following quality standards is burdensome and laborious, and only 3% (*n*=4) of them strongly agreed. Among the respondents, 29% (*n*=34) disagreed that complying with a quality management system requires more employees, with 27% (*n*=32) of them being neutral about this factor. Half of the respondents (*n*=59) strongly disagreed that quality assurance builds barriers between workers, while the other 40% (*n*=47) agreed, and only 1 respondent strongly disagreed.

Regarding the statement: quality management system requires extra credentials, advanced skills, and additional training, 39% (*n*=46) agreed, and 13% (*n*=15) disagreed. Moreover, 30% (*n*=35) of the total respondents disagreed that proficiency in quality assurance practice is significantly affected by educational attainment, 26% (*n*=30) agreed, and the remaining quarter (*n*=29) answered neutral. From the total number of respondents, 28% (*n*=33) disagreed that proficiency in quality assurance practice is significantly affected by age and work experience. However, both 21% (*n*=25) of the total respondents agreed and cannot decide about this factor. Lastly, a total of 38 respondents (32%) disagreed that proficiency in quality assurance is significantly affected by laboratory position or job position, and only 7% (*n*=8) strongly agreed.

D. Correlation of Sociodemographic Factors on the Practices of Medical Technologists in the Laboratory

Sociodemographic factors that were correlated with the practices of medical technologists in the laboratory include their educational attainment, annual income, length of practice, and position in charge. Spearman Rank was used to correlate these variables with the practice of quality assurance.

Table.8. Correlation of Sociodemographic Factors on the Practices of Medical Technologists in the Laboratory

Coefficient	Estimate
Educational Attainment vs. Practices	
p	0.1299
p-value	0.1627
Annual Income vs. Practices	
p	0.0995
p-value	0.2858
Length of Practice vs. Practices	
p	0.0831
p-value	0.3733
Position in Charge vs. Practices	
p	- 0.0944
p-value	0.3115

Note. Values were rounded to two decimal places prior to the interpretation of the level of correlation. This study used an alpha level of 0.05 for all statistical tests.

Table.8. summarized the correlation of sociodemographic factors such as the educational attainment, annual income, length of practice, and employee position on the practice of laboratory quality assurance of medical technologists in selected level III hospitals in Davao City. The coefficient estimate obtained for the correlation between the educational attainment and practice of laboratory quality assurance of the respondents was (p = 0.1299), which can be interpreted as a very weak positive association between the mentioned variables. Consequently, it indicated that the educational attainment of the medical technologists was not significantly (*p-value* = 0.1627) associated with their practice of laboratory quality assurance inside the laboratory. On the annual income vs. practice of quality assurance in the laboratory, an estimate of (p = 0.0995) indicated a very weak positive association between the two variables and was not significant (*p-value* = 0.2858). Consequently, there was a very weak positive association between their length of practice and the practice of laboratory quality assurance of the respondents (p = 0.0831) with no significant association (*p-value* = 0.3733). On the other hand, the employee position of medical technologists had no significant association (*p-value* = 0.3115) to their practice of laboratory quality assurance with a very weak negative association of (p = - 0.0944).

E. Discussion

This study assessed the knowledge, attitudes, and practices of medical technologists on laboratory quality assurance programs in selected level III hospitals in Davao City with a survey-questionnaire and determined the sociodemographic factors affecting their practices of laboratory quality assurance. The researchers inquired if education, income, employee position, and length of practice contributed significantly to the practice of quality assurance among medical technologists in selected level III hospitals in Davao City. The survey questionnaire primarily addressed five (5) factors that affect laboratory quality assurance: knowledge, and attitude of medical technologists, main perceived impediments, how often medical technologists comply with quality assurance procedures and protocols, as well as the sociodemographic factors.

Perceptions of Medical Technologists in Terms of KAP

Table 4. Knowledge on Quality Assurance in the Laboratory

Knowledge refers to the familiarity among medical technologists on selected level III hospitals in Davao City with general quality assurance principles. In this study, it was found that the respondents erroneously answered some statements. Results related to knowledge on quality assurance in the laboratory were examined by the researchers through findings in Figure 5.

Statement 1: Quality assurance involves the preanalytical, analytical, and post-analytical phases of the laboratory. The data revealed that 93% of the respondents strongly agreed that quality assurance is involved in the three phases of the laboratory. According to Agarwal (2014), quality assurance is a management strategy significant in the phases of the laboratory which involves identification of patients, ordering of the tests, collection of specimens, testing, and transportation. Quality assurance aids in the identification and prevention of errors during these phases.

Statement 2: A sensitive test has a low false-negative rate. It was found that more than half of the respondents strongly

agreed that a sensitive test has a low false-negative rate. This means that fewer cases of disease are missed.
Statement 3: Accreditation is the goal of quality assurance. 45% of the respondents strongly agreed to the aforementioned statement. However, the goal of quality assurance is to ensure quality and reliable service, and, At the same time, build confidence in meeting quality requirements (ISO 9000).

Statement 4: It is the responsibility of every medical technologist to attain quality assurance in the laboratory. The findings revealed that 88.9% of the participants strongly agreed that attainment of quality assurance is self-responsibility (Rogers, Letsos, Henderson, Willis & McCudden, 2018).

Statement 5: A certificate of participation in an External Quality Assurance Program (EQAP) is a requirement for the renewal of the license of clinical laboratories under Philippine law. Seventy-six percent of the total respondents strongly agreed to the statement. As stated in relevant Philippine law (Administrative Order 2007-0027 and Department Memorandum No. 2009-0086-B), clinical laboratories in the Philippines are required to participate in the External Quality Assurance Program and a certificate of participation on EQAP or proficiency testing shall be submitted for renewal of a license to operate of clinical laboratories (Duque, 2007; Lutero, 2014).

Statement 6: The standard deviation measures the accuracy of a laboratory test. More than half of the respondents strongly agreed that the accuracy of a laboratory test is measured by standard deviation. However, the standard deviation is a statistical measure that quantifies precision, not accuracy, for a series of repeated measurements of a laboratory test (Rogers, Letsos, Henderson, Willis & McCudden, 2018).

Statement 7: Unknown samples under the External Quality Assurance Program (EQAP) are prepared by national reference laboratories. The majority of the respondents strongly agreed that unknown samples are prepared by national reference laboratories. External Quality Assurance Program is a program where participating laboratories are given an unknown sample prepared by a national reference laboratory to be treated as ordinary human specimens for the usual processing and examination (Duque, 2007).

Statement 8: Specificity is a measure of a test's ability to detect positive cases. Among the respondents, 32% agreed and 38% strongly agreed to the statement. However, specificity is a measure of a test's ability to detect negative cases. It is also known as the true-negative rate. Sensitivity should be the term used since it measures a test's ability to detect positive cases (Rogers, Letsos, Henderson, Willis & McCudden, 2018).

Statement 9: A urine specimen labeled with the patient's name "Pedro" is acceptable. Findings revealed that 94% of the respondents strongly disagreed with the statement. On the other hand, 5% disagreed while there is still a remaining 1% who strongly agreed. A urine specimen labeled with the patient's name "Pedro" is unacceptable since specimens submitted to the laboratory should be properly labeled with the patient's full name.

Statement 10: The purpose of quality control materials (e.g. control samples) is to calibrate laboratory instruments. Thirty-eight percent of the respondents strongly agreed with the statement. The purpose of quality control materials (e.g., control samples) is not to calibrate laboratory instruments but to ensure that the results are valid (Rogers, Letsos, Henderson, Willis & McCudden, 2018).

Statement 11: Voltage fluctuations in a laboratory instrument are a systematic and predictable error. The data revealed that 34% of the respondents strongly disagreed with the aforementioned statement. Instead of "voltage fluctuations in a laboratory instrument are a systematic and predictable error," it should be "voltage fluctuations in a laboratory instrument are a random and unpredictable error." (Rogers, Letsos, Henderson, Willis & McCudden, 2018).

Statement 12: Quality assurance helps medical technologists and the laboratory attain a more accurate and precise result. It was found that 84% of the respondents strongly agreed with the statement. In general, accreditation programs appear to improve the structure and process of care, with good evidence demonstrating that they improve clinical outcomes (Alkenizan & Shaw, 2011). Furthermore, accreditation possibly elevates laboratory testing efficiency and reliability of test results (Horvath et al., 2005).

Statement 13: The World Health Organization (WHO) provides quality and testing standards to clinical laboratories. Findings revealed that less than half of the total respondents strongly agreed with the statement. The World Health Organization formulated a handbook intended to provide a comprehensive reference on Laboratory Quality Management System based on

both ISO 15189 and CLSI GP26-A3 documents. Additionally, the organization provided a checklist for laboratory quality standards which may be used to establish a baseline of quality standards implementation and its monitoring (WHO, 2011).

Statement 14: Quality control is a day-to-day activity. Eighty-five percent of the total respondents strongly agreed with the statement. According to the World Health Organization (2011), running control samples and control chart plotting are daily activities done in every test run. In order to prevent errors, daily calibration, monitoring and maintenance should be practiced inside the laboratory.

Statement 15: A test result is valid if one control value exceeds 3 standard deviations from the mean. More than half of the population strongly disagreed that a test result is valid if one control exceeds 3 standard deviations from the mean. According to Westgard Rules and Levey-Jennings Chart, a test result is rejected when a single control measurement exceeds the mean +/-3 control limit. Therefore, if one control value exceeds 3 standard deviations from the mean, the test result is invalid (Rogers, Letsos, Henderson, Willis & McCudden, 2018).

Table 5. Attitude towards the Significance of Quality Assurance in the Laboratory:

The attitudes of the medical technologists were identified based on their views on the beneficiality and significance of quality assurance inside the laboratory. The degree to which fulfillment of patient expectations are met is a fundamental characteristic that is assessed while estimating the advancement in quality results. In accordance with Figure 6, at least 94% of the respondents concurred that quality assurance reduces complaints from customers indicating that customer satisfaction and loyalty are ensured. Similar studies had shown evidence that all processes vital in health services delivery necessitate control by a quality management system that incorporates a progression of interfacing practices that intend to screen, evaluate, and improve the quality of care given to the patients (Hijazi et al., 2018). These findings are supported by the Ethiopian study that illustrated 78.6% overall satisfaction level of patients attained among the medical laboratory services of sixty public hospitals whose accreditation is managed by the Ethopian Public Health Institute (EPHI) quality improvement and accreditation team; it was also described in the study that monitoring patients' satisfaction in a clinical laboratory setting is an essential indicator of the presence of quality management system and a requirement by laboratory quality standards including ISO 15189: 2012 and ISO 17025: 2017 (Hailu et al., 2020).

A test incorrectly executed is more noticeably unacceptable than a test not done. Quality assurance is a guarantee that a test is prevented from being executed incorrectly, it is intended to recognize, diminish, and improve insufficiencies during the analytical phase in the laboratory to be able to execute test processes more efficiently and release patient results with the optimum quality (Rahman, 2011; WHO, 2011). In view of the foregoing results, almost all respondents, with little to no percentage that remained impartial or undecided, saw quality assurance as a process that prevents erroneous outcomes at an early stage, ensures non-faulty and accurate results, efficient in laboratory performance, and aids in increased quality of laboratory outputs. "External quality assurance" serves as a distinct benchmark in clinical laboratories; it was defined to diminish inconsistency in test results by continuously evaluating every laboratory's individual performance (Groene, Kringos, & Sunol, 2014).

As is well known, part of medical technologists' responsibilities is to deliver quality control and assurance by eradicating inadequate service and unsatisfactory patient evaluations (Blumen et al., 2010). Considering this critical role, they have one of the greatest opportunities to assess the aspects that may hinder them in formulating wise decisions (Agrawal, 2014). This not only cultivates collaboration between workers, as believed by most of the respondents of this study but is also regarded to encourage personal responsibility and willingness to maintain efforts in decision-making and performing laboratory procedures. Our findings showed consistency with those of other researches wherein a few researchers argued that the quality of test outcomes unequivocally relies upon the health staff (Wardhani et al., 2009). Related studies have likewise shown that the responsibility and contribution of the staff in estimating the quality indicators highly affect the success of quality assurance outcomes (Weiner et al., 2006; Aghaei Hashjin, 2015). At the point when medical services heads, suppliers, patients and families work in association, the quality and security of medical care increases, expenses lessen, satisfaction level rises, and patient care experience develops (Luxford, Piper, Dunbar, & Poole, 2010); for this reason, quality management system cultivates professional growth,

essentially an advantage to gain new skills and work experience for the medical technologists.

In multisite studies, the high number of medical technologists who acknowledged quality management as a system that encourages continuous improvement was backed up by a study by Kupiec (2006) where he described that as different practices inside the laboratory to advance constantly, quality control and assurance evolve along with it as it promotes up to date obstacles laboratories potentially will encounter.
Additionally, as Shaller (2007) claimed, the deliberate measurement of quality improvement and documentation of assessment are both distinguished as helpful instruments in learning the impacts of advancement in interventions and procedures used in quality assurance inside the hospitals, including accreditation. In medical care quality improvement, it is notably perceived that "what is immeasurable cannot be managed"; on that account, the need for quality management increases as it aids in the supplemental quality of laboratory outputs.

Table 6. Practices of Medical Technologists inside the Laboratory:

Practice refers to how frequently medical technologists perform quality assurance inside the laboratory. Despite the impediments encountered by many medical technologists, most respondents of the two Davao City tertiary hospitals reported to be compliant with laboratory quality assurance. All agreed that their laboratories and themselves practice quality assurance and comply with quality protocols often or always. Also, only 17% repeated a test at least often due to an error in the machine. The rates were comparable to the Ethiopian study that learned that 81.7% of medical technologists had practiced internal quality control and 31.5% had faced a failed result (Dereje Mamuye et al., 2018) and superior to the Lahore study, where 66% were rated poor concerning quality assurance practices (Azhar et al., 2011).

From the results, medical technologists had better compliance than their nationwide peers. Belizario, Plan, and de Leon (2014) noted that among parasitology laboratories assessed in Iloilo City, only about 1 in 10 (9.1%) followed updated standard operating procedure manuals (SOPs) and 36.8% lacked both quality control and the necessary reagents and supplies. In the present study, there were nine respondents who were working in the Microbiology section, and all reported they often or always had the appropriate diluents and the right preservatives before testing. Another report from NEQAS surveyed bacteriology laboratories nationwide in 2008 discovered that only 17.3% of labs implemented IQC procedures for media, reagents, stains, and antibiotic disks, and only 35.7% had a complete instrument and reagent inventory. This contrasted the near to full compliance and completeness of materials as evaluated by the medical technologists in our study.

One notable similarity between the two target hospitals in our study was that both had a history of acquiring accreditation. Brokenshire Hospital was granted ISO 9001:2008 certification in 2006, and Southern Philippine Medical Center (SPMC) was awarded an ISO 9001:2015 certification in 2018. Although some studies found that accreditation had mixed effects on the operational performance or the clinical outcomes in healthcare facilities (Ratseou & Ramphal, 2014; Swathi, Gopalkrishna, & Somu, 2020), a systematic study evaluating 26 hospitals, laboratories, and subspecialty programs affirmed a positive association between accreditation and healthcare (Alkhenizan & Shaw, 2011). Additionally Horvath et al. (2005) argued that accreditation might elevate the efficiency of lab testing and boost the reliability of test results.

Table 7. Attitude towards Impediments Affecting Quality Assurance in the Laboratory:

Impediments encountered inside the laboratory by medical technologists were used to identify their attitude towards laboratory quality assurance. Adapting to a new system may be unwieldy to some medical technologists more familiar with manual systems, and they may perceive this as an impediment given their uncertainty to variation of procedures (WHO, 2011). Several respondents from selected tertiary hospitals in Davao City agreed with the idea that following quality standards is time-consuming, although there were more who believed otherwise, and this is because one of the few reasons that maintenance of quality assurance and quality control is significant inside the laboratory is that this process leads to reliable, and definitive diagnosis in the shortest possible time, which enables physicians to treat patients promptly, thus saves working time, manpower, and money (Rahman, 2011). On the contrary, implementation of quality control is considered as an additional expense despite its usefulness, hence the majority of the respondents agreed that maintenance of quality service and the product is costly. Due to insufficient funding and lack of amenities and infrastructures, laboratories mentioned in an

African study resort to manual processing, which results in unpreventable errors that require the implementation of quality control (Nnakenyi, Ugonabo, & Meka, 2015); consequently, the number of medical technologists in this study who disapproved of quality assurance not preventing waste of resources in cases of errors, such as repetition of tests, troubleshooting, etc., outweighed those who agreed with it by a small percentage.

In comparison with the study conducted by Mamuye et al. (2018), wherein the rationale of their participants for tests not being able to undergo internal quality control was due to the amount of work (22.9%), challenges in preparation of materials used in quality control (14.9%), expensive cost of materials (28.6%), insufficient supply (13.7%), lack of time (6.3%), and lack of staff (10.3%); while the majority of the respondents for this study attributed impedance of quality assurance to be time-consuming and costly, but not due to requiring more employees, nor burdensome and laborious. Since the function of quality assurance is to ensure that errors are kept to a minimum, the performance of laboratory staff is evaluated and compared enabling them to monitor their errors and keep up with their objectives. This is beneficial for them to be encouraged in performing better and lessening their workload inside the laboratories (Plebani, 2009).

Opposition to half of the populace who strongly disagreed that quality assurance builds barriers between workers, one of the hindrances stated in another study was the resistance of professionals to change, an occurrence wherein changes brought by quality assurance programs (e.g. change in power, influence, and status of staff) negatively affect the quality of service given by the health personnel. This, in turn, impedes the quality assurance provided inside laboratories (Luke & Boss, 2017). While most respondents believed that quality assurance does not negatively influence establishing effective working relationships within the laboratories, the existing numbers of literature provide no clear evidence that quality assurance can actually contribute to the enhancement of relationships between workers. Accordingly, the major factors that affect the quality of laboratory services include poor quality of human resource management, insufficient resources, ineffective communication systems, and absence of well-established system management (Mesfin, Taye, Belay, Ashenafi, & Girma 2017). The weak laboratory quality system influences these constituents, because many professionals refrain from participating in their external quality assessment such as those in Addis Ababa Ethiopia, thus explaining why a greater part of the medical technologists in this study concurred with quality management system requires laboratory staff to possess extra credentials, advanced skills, and additional trainings.

The medical technologists from selected tertiary hospitals in Davao City discerned proficiency in quality assurance as not significantly affected by educational qualification status, age, work experience, and job position inside the laboratory. Comparably, a study in Nepal stated that the educational level, and work experience of the laboratory personnel were found to be significantly associated with more enhanced performances in internal quality control preparation, while age, sex and training were of no significant associations with their performance (Pakrash, 2017). Better quality control practices were associated with educational attainment wherein those who graduated with a degree or a master's degree performed more effectively than those with diploma only. Moreover, those with longer experience seemed to have better practices compared to less working experience. Nonetheless, the level of education and their attitude are not always an indication of good quality assurance performances. Other major factors such as participation in training, responsibilities, work experiences are needed to improve the quality of service provided by the laboratory staff (Dereje Memuye et al., 2018).

Table 8. Correlation of Sociodemographic Factors on the Practices of Medical Technologists in the Laboratory:

In the study of Dereje Mamuye et al. (2018), the sociodemographic characteristics of respondents influenced the practice of quality control among medical laboratory professionals. In contrast to the study of Dereje Mamuye et al. (2018), wherein those who have a degree and postgraduate of master's degree educational qualification practiced IQC better compared to those with a diploma level, the results of this study showed no association regarding the educational attainment of the medical technologist to his or her quality assurance practice. This could be due to the small representation of medical technologists with master's degrees with only 5 out of 117 respondents, hence, only a very weak positive association was seen.

Similarly, the study of Dereje Mamuye et al. (2018) found that better practices of IQC were associated with health workers who have a longer work experience compared to those with less work experience. These findings from Dereje Mamuye et

al. (2018) showed contrasting results in this study since length of practice did not show any correlation to the practice of quality assurance in Brokenshire Hospital and Southern Philippines Medical Center in Davao City. In another study from Ethiopia, the trained and experienced laboratory professionals working in health institutions were also surveyed using a questionnaire. It was revealed in this study that some medical professionals did not perform calibration and maintenance, as well as follow the instructions. The respondents also indicated that some laboratory professionals did not participate in the external quality assessment and improvement activities (Mesfin et al., 2017). This showed that laboratories with trained professionals with higher and longer working experience would not specify that the laboratory would have a better quality assurance system than those with lesser working experience which can be attributed to the results of this study when it was correlated with laboratory quality assurance practice in Brokenshire Hospital and Southern Philippines Medical Center in Davao City.

Moreover, a study of Vujicic (2009) suggested that, although health workers would frequently report that low income would be a barrier to performance, there is little evidence showing that increasing their income would improve performance. It was also stated that simply increasing the salary of health workers would not be an effective strategy to increase or improve the working performance of the workforce. This may be seen through the data obtained in this research wherein no significant association was found between the annual income of medical technologists to their practice of quality assurance inside the laboratory.

Particularly, employee positions do not affect the practice of medical technologists on laboratory quality assurance in Brokenshire Hospital and Southern Philippines Medical Center. In relation to this, a study by Dereje Mamuye et al. (2018) emphasized that department heads and quality officers have taken laboratory quality management training more often compared to those with lower positions. One of the major factors that affect quality assurance is the lack of training (Mesfin et al., 2017), which is important for all capacity-building efforts, but it is also stated that training itself may not be sufficient to maintain the quality of laboratory work since resources, equipment, management system, adequate staff, and knowledge also contribute to this. The purpose of the said training is to address deficiencies observed from assessments and introduce quality assurance and instrumentation (Abimiku et al., 2010). On another note, the study of Abimiku et al. (2010) suggested that excellent tools in monitoring site performance and evaluating training materials and processes include training evaluations, teach-back, assessments, and pre- and post-training tests.

Results for the sociodemographic characteristics mentioned above indicated that with a very weak positive relationship, except for the position in charge which had a very weak negative relationship with practice, they did not significantly correlate to the practice of quality assurance in the laboratory. But it is important to know that other factors such as participation in training, responsibilities, and work experiences should be considered to improve the quality of service provided by the laboratory staff (Dereje Memuye et al., 2018).

V. Summary, Conclusion, And Recommendations

A. Summary

Quality assurance involves the preanalytical, analytical and post-analytical stages of the laboratory. It is used to achieve and maintain quality, relevant, and timely results in practices. In this study, the researchers assessed the knowledge, attitude, and practices regarding quality assurance among medical technologists in Davao City. A quantitative with a mix of descriptive and inferential statistical research tools were used as the research design. Data were drawn from 117 respondents from Brokenshire Hospital and Southern Philippines Medical Center in Davao City using a survey questionnaire. Eighty-six of the respondents were female and 28 were male. The objectives of the researchers were to assess the knowledge, determine the attitude, identify the main perceived impediments, assess compliance and correlate sociodemographic factors to laboratory quality assurance practice.

In order to assess the knowledge of respondents, 15 statements in the questionnaire were asked in a five-point Likert scale. For the 1st statement, 93% strongly agreed that quality assurance involves the three phases of the laboratory. For the 2nd statement, 53% strongly agreed that a sensitive test has a low false-negative rate. For the 3rd statement, 45% strongly agreed that accreditation is the goal for quality assurance. For the 4th statement, 88.9% strongly agreed that the attainment of quality assurance is a responsibility. For the 5th statement, 76% strongly agreed that a certificate for the external quality assurance program (EQAP) is a requirement for renewal of

laboratory license under Philippine law. For the 6th statement, 59% strongly agreed that standard deviation measures the accuracy of tests. For the 7th statement, 79% strongly agreed that unknown samples under EQAP are prepared by national reference laboratories. For the 8th statement, 38% strongly agreed that specificity is a measure of a test's ability to detect positive cases. For the 9th statement, 94% strongly disagreed that a urine specimen labeled with *"Pedro"* is acceptable. For the 10th statement, 38% strongly agreed that the purpose of quality control materials is for calibration. For the 11th statement, 34% strongly disagreed that voltage fluctuation in a laboratory is a systematic error. For the 12th statement 84% strongly agreed that quality assurance helps medical technologists attain a more accurate and precise result. For the 13th statement, 44% strongly agreed that WHO provides quality testing standards to laboratories. For the 14th statement, 85% strongly agreed that quality control is a day-to-day activity and lastly for the 15th statement, 60% strongly disagreed that the test is valid if one control exceeds 3 standard deviations from the mean.

In order to assess the attitude of the respondents, 10 statements in the questionnaire were asked in a five-point Likert scale. For the 1st statement, 67% strongly agreed that quality assurance reduces complaints from customers. For the 2nd statement, 70% strongly agreed that quality assurance ensures customer satisfaction and loyalty. For the 3rd statement, 73% strongly agreed that quality assurance prevents error at early stages. For the 4th statement, 72% strongly agreed that quality assurance ensures accurate results. For the 5th statement, 79% strongly agreed that quality assurance results in efficient laboratory performance. For the 6th statement, 73% strongly agreed that the quality management system cultivates worker collaboration. For the 7th statement, 82% strongly agreed that the quality management system encourages continuous improvement. For the 8th statement, 68% strongly agreed that quality assurance encourages responsibility and efforts. For the 9th statement, 76% strongly agreed that the quality management system cultivates growth and is an advantage to gain a new skill and work experience, and, lastly, for the 10th statement, 73% strongly agreed that quality management aids in increasing the quality of output.

In order to assess the compliance, 15 statements in the questionnaire were asked. For the 1st statement, 87% always practiced quality assurance. For the 2nd statement, 87% always complied with the rules and regulations for quality assurance. For the 3rd statement, 97% always identified the patient properly before specimen collection. For the 4th statement, 84% always readily prepared reagents and dilutions before testing and examination. For the 5th statement, 98% always collected specimens at the right container. For the 6th statement, 97% always used the right preservatives or anticoagulants. For the 7th statement, 94% always stored at tight storage conditions. For the 8th statement, 85% always took into consideration the turnaround time. For the 9th statement, 52% rarely experienced specimen contamination. For the 10th statement, 55% rarely repeated tests due to machine error. For the 11th statement, 80% always checked for contaminated or expired reagents. For the 12th statement, 52% rarely had incorrect calculations. For the 13th statement, 60% always calibrated machines. For the 14th statement, 94% always recorded and reported results and lastly for the 15th statement, 94% always ensured test results were interpreted correctly.

In order to assess the impediments of respondents, 10 statements in the questionnaire were asked in a five-point Likert scale. For the 1st statement, 29% agreed that following quality standards is time-consuming. For the 2nd statement, 37% agreed that maintenance of quality assurance is costly. For the 4th statement, 29% agreed that quality assurance does not prevent waste of resources through errors. For the 5th statement, 29% disagreed that compliance with quality assurance requires more employees. For the 6th statement, 50% strongly disagreed that quality assurance builds barriers between workers. For the 7th statement, 39% agreed that a quality management system requires extra credentials, skills and training. For the 8th statement, 30% disagreed that proficiency in quality assurance is affected by educational attainment. For the 9th statement, 28% disagreed that proficiency in quality assurance is affected by age and work experience and lastly for the 10th statement, 32% disagreed that proficiency in quality assurance is affected by laboratory job position.

Sociodemographic factors such as educational attainment, annual income, length of practice, and position in charge were correlated with laboratory quality assurance practice based on the last part of the survey questionnaire of medical technologists with questions about compliance. Educational attainment, annual income, and length of practice had no significant ($p > 0.05$) association to the practice of laboratory quality assurance of the respondents with a very weak positive

association (p = 0.00 to 0.19). On the other hand, there was a very weak negative association (p = -0.10 to -0.01) with the employee position of medical technologists when correlated with their practice of laboratory quality assurance, and it also yielded no significant association ($p > 0.05$).

B. Conclusion

In terms of knowledge, the gathered data showed that the majority of medical technologists answered all but four statements correctly. These statements were based on a specific study or book and were asked through a Likert scale. In terms of attitude, the gathered data indicated that most medical technologists in selected level III hospitals in Davao City believed that quality assurance is significant and beneficial to laboratory performance, collaboration, and testing output. In terms of perceived impediments, the results showed that the level of agreement of the respondents was spread. In terms of practice, medical technologists were compliant with laboratory quality assurance protocols, and testing errors were encountered rarely. The main impediments agreed by the respondents were costly maintenance of quality, as well as service and requirement of extra credentials, advanced skills and additional training. In terms of sociodemographic factors, laboratory quality assurance practice of medical technologists in selected level III hospitals in Davao City was not significantly affected by educational attainment, annual income, employee position and length of practice.

C. Recommendations

The assessment of medical technologists' knowledge, attitude, and practice was only limited to two hospitals, namely, the Brokenshire Hospital and Southern Philippines Medical Center (SPMC). Respondents from these hospitals were chosen by convenience sampling, a nonprobability sampling, due to the limited access to the respondents brought about by the restrictions and limited dissemination of the pandemic. It is recommended to conduct research with a similar purpose and duration where limitations, such as community quarantines, are eliminated. It would be feasible for future researchers to deliberately select an applicable sampling method that could indicate a more appropriate representation of the sample populace.

In order to have the extent to which sample statistics distinguished from population parameters and to draw valid inferences, the researchers recommend using a probability sampling method in future similar studies. Moreover, the number of respondents, if increased, will also yield better results.

Another limitation is that the current study targeted only two tertiary hospitals located in Davao City. Thus, the study findings cannot be generalized to other hospitals in the country. There is an apparent need for further larger-scale studies.

Further, only the correlation between the practices of medical technologists in the study and each socio-demographic variable was tested. Subsequent KAP studies should consider assessing the correlation between knowledge, attitudes, and practices, as well as the statistical relationship between knowledge and attitudes to the socio-demographic variables to obtain a comprehensive picture of the state of laboratory quality assurance in Davao City.

With the use of self-reported questionnaires, it can be inferred that social desirability bias can be a disadvantage since the respondents usually answer in a way that depicts them and the organization they are affiliated with in a good light, hence other data gathering methods are also recommended such as the use of open-ended questions in order to extract meaningful themes regarding the knowledge, attitude, and practice of medical technologists regarding quality assurance in the laboratory.

Lastly, the researchers encourage further research concerning the impacts of accreditation in Philippine laboratories, as they allow the exploration of how quality assurance implementation may influence the practices of medical technologists in the country.

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