

Awareness and Practices on Pre-Analytical Laboratory Errors Among Medical Technology Interns of a University

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ABSTRACT: The pre-analytical phase remains the most error-prone stage of laboratory testing, accounting for over 60% of diagnostic errors. As frontline contributors to specimen collection and handling, Medical Technology interns play a pivotal role in maintaining laboratory quality. This study aims to assess the level of awareness and clinical practices regarding pre-analytical errors among fourth-year Medical Technology interns at the University of Perpetual Help - Dr. Jose G. Tamayo Medical University for the Academic Year 2025–2026.

Anchored on the Dreyfus Model of Skill Acquisition, the research evaluates how theoretical knowledge transitions into clinical competence. The study employs a descriptive-quantitative research design, utilizing a survey-based questionnaire to determine the interns' recognition of error-prone procedures, their adherence to standardized protocols (such as patient identification, phlebotomy techniques, and specimen transport), and the frequency of errors encountered during their internship at the Perpetual Help Medical Center.

Preliminary literature suggests that while interns often possess high theoretical awareness, a "knowledge-practice gap" exists due to workload pressures, clinical environment complexities, and limited hands-on exposure. The findings of this study are intended to provide evidence-based insights for Clinical Training Officers and Educators to refine internship orientation programs, enhance supervisory frameworks, and implement targeted competency-based interventions. Ultimately, the study seeks to foster a culture of precision and safety among future medical technologists, ensuring the delivery of reliable laboratory results and improved patient care outcomes.

KEYWORDS: Pre Analytical Laboratory Errors, Medical Technology Interns, Awareness, Practices

INTRODUCTION

Laboratory testing plays a crucial role in disease diagnosis, treatment monitoring, and patient management, with the accuracy of results highly dependent on the proper execution of the pre-analytical phase. This phase includes patient preparation, specimen collection, identification, labeling, handling, storage, and transport, where errors may lead to inaccurate results, delayed diagnosis, repeated specimen collection, and compromised patient safety. Studies have shown that most laboratory errors occur during the pre-analytical stage due to human factors, procedural lapses, and communication problems. Gao (2020) reported that more than 60% of laboratory errors occur during this phase, while Chhillar et al. (2021) emphasized that common errors such as mislabeled specimens, hemolyzed samples, insufficient specimen volume, contamination, delayed transport, and incomplete request forms are largely preventable through proper training and adherence to laboratory protocols.

Medical Technology interns actively participate in laboratory procedures during clinical internship and may encounter challenges such as workload pressure, unfamiliar clinical environments, multitasking, and limited supervision that can affect performance. Assessing their awareness and practices regarding pre-analytical laboratory errors is therefore important in strengthening internship training and improving patient safety. Hence, this study aimed to assess the awareness and practices of Medical Technology interns

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regarding pre-analytical laboratory errors and determine the specific errors most frequently encountered during laboratory procedures.

METHODS

1.1 Research Design

The study employed a descriptive-correlational cross-sectional research design to study the correlation between medical technology interns' awareness and actual practices in pre-analytical laboratory procedures without interference. This design was appropriate because it described the current level of awareness and practices of Medical Technology interns and examined patterns related to pre-analytical laboratory errors at a specific point in time (Creswell & Creswell, 2021).

1.2 Participants

The respondents of the study were 83 fourth-year Medical Technology interns from the College of Medical Technology of the University of Perpetual Help-Dr. Jose G. Tamayo Medical University who were enrolled and undergoing clinical internship during the First Semester of the School Year 2025-2026. Purposive sampling was utilized in selecting the respondents, as the researchers intentionally chose fourth-year Medical Technology interns who were actively undergoing clinical internship and directly exposed to pre-analytical laboratory procedures, making them the most appropriate participants for the study. The collected data were analyzed to determine the relationship between the interns' awareness, practices, and possible pre-analytical error occurrences.

1.3 Research Instrument

The primary instrument used in this study was a researcher-made structured questionnaire based on established CLSI guidelines, underwent content review, expert validation, pilot testing with 30 interns, and reliability testing using Cronbach's alpha to ensure validity and consistency. The questionnaire consisted of four parts: respondent profile, awareness regarding pre-analytical laboratory errors, practices in preventing errors, and commonly encountered errors during clinical internship. Moreover, a Likert scale was used to measure the respondents' awareness.

The instrument underwent content validation by qualified experts and pilot testing to determine clarity, reliability, appropriateness of the items included in the questionnaire and consistency of responses before final administration.

1.4 Data Gathering Procedure

Prior to data collection, the researchers secured approval from the research adviser and appropriate institutional authorities. After approval was granted, the survey questionnaires were distributed to the selected respondents during the data gathering period from December 2025 to late January 2026. The purpose of the study was explained to the respondents, and informed consent was obtained before participation. The accomplished questionnaires were collected, checked for completeness, and organized for data analysis.

1.5 Statistical Treatment of Data

The collected data were encoded, tabulated, and analyzed using Microsoft Excel with the assistance of an assigned statistician. Descriptive statistical tools such as frequency count and percentage were used to determine the proportion of pre-analytical laboratory errors encountered by the respondents. Weighted mean and standard deviation were used to assess the respondents' awareness and practices regarding pre-analytical laboratory errors.

1.6 Ethical Considerations

The study observed ethical principles throughout the research process. Approval was obtained from the appropriate institutional authorities, and participation was voluntary with informed consent provided by each respondent. In accordance with the Data Privacy Act of 2012 (RA 10173), no identifiable personal information was disclosed in the study to ensure the privacy, anonymity, and protection of the participants. The obtained data was securely maintained and handled in accordance with ethical and data protection standards, and proper disposal was carried out after the study was completed.

RESULTS

1. Awareness on Pre-Analytical Laboratory Errors

Table 1. Respondents' Awareness on Pre-Analytical Laboratory Errors

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
1. Errors during patient identification are recognized as a leading cause of pre-analytical mistakes, as stated in ISO 15189 and CLSI standards.	3.69	0.71	Very High	6
2. Incorrect specimen labeling is known to significantly contribute to pre-analytical errors.	3.76	0.64	Very High	4
3. Improper selection of specimen containers or anticoagulants is identified as a common cause of sample rejection.	3.69	0.64	Very High	6
4. Failure to follow the correct venipuncture order of draw is a documented cause of hemolysis and additive carryover.	3.58	0.77	Very High	9
5. Inadequate mixing of anticoagulated specimens is recognized as a cause of clotting and compromised sample quality.	3.59	0.77	Very High	8
6. Incomplete or inaccurate laboratory request forms are established contributors to pre-analytical error rates.	3.78	0.54	Very High	3
7. Delayed transport of specimens is known to affect sample stability and analyte reliability.	3.80	0.51	Very High	2
8. Improper specimen containers or anticoagulants are regarded as a major contributor to specimen rejection.	3.81	0.53	Very High	1
9. Lack of staff competency or training contributes to the increased occurrence of pre-analytical errors.	3.54	0.74	Very High	10
10. Absence of proper documentation and error-tracking systems can increase the risk of repeated pre-analytical procedures.	3.73	0.63	Very High	5
Mean	3.70		Very High	

Table 1 showed an overall weighted mean of 3.70, verbally interpreted as **Very High**, indicating that the respondents had a high level of awareness regarding pre-analytical laboratory errors and their effects on laboratory accuracy. The highest-ranked indicator was the recognition that improper specimen containers or anticoagulants contribute to specimen rejection (WM = 3.81), while the lowest-ranked indicator was the lack of staff competency or training contributing to pre-analytical errors (WM = 3.54). Although all indicators were interpreted as **Very High**, the findings suggest that respondents were slightly more aware of process-related factors than personnel-related factors.

These findings support the studies of Gao, J. (2020) and Plebani, M. (2021), who emphasized that human performance and personnel competency are major contributors to laboratory errors during the pre-analytical phase. Similarly, Cervantes, M. J. D. et al. (2024) and Kulkarni, K. K. et al. (2020) reported that competency-related knowledge gaps may still exist among students and interns.

Overall, the findings indicate that while respondents demonstrated high awareness regarding pre-analytical laboratory errors, greater emphasis on personnel competency, training, and human performance remains necessary to further reduce laboratory errors and improve laboratory accuracy.

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2. Practices on Pre-Analytical Laboratory Errors

Table 2. Respondents' Practices on Pre-Analytical Laboratory Errors

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
1. Patient identity is always verified using at least two identifiers to prevent misidentification errors.	3.77	0.63	Always	8
2. Specimen containers are labeled immediately after collection and in the presence of the patient to ensure accurate identification.	3.88	0.48	Always	1
3. The correct specimen container and appropriate anticoagulant are selected based on the test requirements.	3.88	0.48	Always	1
4. The standardized order of draw is followed during venipuncture to minimize contamination and prevent additive interference.	3.77	0.57	Always	8
5. Anticoagulated specimens are mixed according to recommended inversion guidelines to prevent clot formation.	3.81	0.59	Always	7
6. Laboratory request forms are reviewed for completeness and accuracy before specimen processing.	3.87	0.49	Always	3
7. Specimens are transported promptly and in accordance with recommended pre-analytical time limits.	3.82	0.52	Always	6
8. Specimens are stored under appropriate temperature conditions to maintain stability and prevent degradation.	3.87	0.46	Always	3
9. Any errors or incidents encountered during specimen collection are documented according to institutional policies.	3.76	0.58	Always	10
10. Biosafety and hazard-prevention practices, including proper sharps handling, are consistently observed to reduce the risk of exposure.	3.86	0.57	Always	5
Mean	3.83		Always	

Table 2 showed an overall weighted mean of 3.83, verbally interpreted as **Very High**, indicating that the respondents reported strong compliance with standard pre-analytical procedures in specimen collection and handling. The highest-ranked indicators (WM = 3.88) were the immediate labeling of specimen containers in the presence of the patient and the correct selection of specimen containers with appropriate anticoagulants. These practices are consistent with CLSI guidelines and institutional standard operating procedures. Meanwhile, reviewing laboratory request forms for completeness and ensuring proper specimen storage both ranked third (WM = 3.87), reflecting good compliance with specimen handling and quality assurance practices.

These findings support the studies of Sadat, Kabir, and Mandal (2023) and Cervantes, M.

J. D. et al. (2024), which emphasized that proper specimen labeling, handling, and correct tube selection are essential in minimizing pre-analytical laboratory errors. The high level of reported compliance in this study may be attributed to effective institutional training, structured internship programs, and adequate clinical exposure among respondents.

Overall, the findings indicate that interns consistently followed proper pre-analytical procedures, particularly in specimen labeling and container selection, which are critical in preventing common laboratory errors. However, the results should still be interpreted with caution since they were based on self-reported practices and may not fully reflect actual laboratory performance.

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3. Pre-Analytical Laboratory Errors Encountered During Laboratory Procedures

Table 3. Respondents' Pre-Analytical Laboratory Errors Encountered During Laboratory Procedures

	Weighted Mean	Standard Deviation	Verbal Interpretation	Rank
1. Incomplete or incorrect test request information (missing patient data, test not clearly indicated).	2.61	1.23	Moderate occurrence	3
2. Wrong patient identification during specimen collection.	2.40	1.31	Low occurrence	11
3. Improper specimen labeling (missing identifiers, wrong identifiers, incomplete label).	2.52	1.26	Moderate occurrence	6
4. Incorrect specimen container or tube type used for the test requested.	2.37	1.33	Low occurrence	14
5. Specimens submitted without the required patient preparation (e.g., fasting not followed).	2.41	1.33	Low occurrence	9
6. Specimens collected at the wrong time (e.g., TDM, GTT, hormone tests).	2.35	1.31	Low occurrence	17
7. Unacceptable specimen quality (e.g., hemolyzed, clotted, contaminated).	2.86	1.14	Moderate occurrence	1
8. Insufficient specimen volume submitted (QNS).	2.72	1.20	Moderate occurrence	2
9. Improper specimen storage before transport (e.g., wrong temperature, delayed processing).	2.43	1.30	Low occurrence	8
10. Improper specimen transport conditions (exposed to heat, sun, delays, agitation).	2.39	1.28	Low occurrence	12
11. Failure to meet specimen preservation requirements (e.g., not placed on ice, not processed promptly).	2.51	1.30	Moderate occurrence	7
12. Lack of adherence to specimen rejection criteria (accepting samples that should be rejected).	2.41	1.31	Low occurrence	9
13. Use of expired collection tubes or materials.	2.36	1.33	Low occurrence	15
14. Incorrect handling of referred specimens (improper packaging or transport to another lab).	2.28	1.29	Low occurrence	19
15. Failure to document and follow written pre-analytical procedures as required by CLIA.	2.39	1.27	Low occurrence	12
16. Inadequate staff training or competency issues related to specimen collection and handling.	2.28	1.26	Low occurrence	19
17. Missing or incorrect information regarding specimen source (when required).	2.53	1.28	Moderate occurrence	5
18. Delays between specimen collection and laboratory receipt that affect specimen integrity.	2.54	1.22	Moderate occurrence	4
19. Failure to verify specimen acceptability upon receipt in the laboratory.	2.36	1.33	Low occurrence	15
20. Specimens collected using procedures not consistent with the lab's CLIA-mandated SOPs.	2.35	1.34	Low occurrence	17
Mean	2.45		Low occurrence	

Table 3 showed an overall weighted mean of 2.45, verbally interpreted as **Low Occurrence**, indicating that pre-analytical laboratory errors were generally not frequently encountered by the respondents. This suggests that proper specimen collection, handling, and

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processing procedures were commonly observed during laboratory activities. However, several indicators still showed a **Moderate Occurrence**, indicating that some specific errors were encountered more frequently than others. Among the indicators, unacceptable specimen quality such as hemolyzed, clotted, or contaminated specimens obtained the highest weighted mean (WM = 2.86), ranked first, indicating that specimen quality issues were the most commonly encountered pre-analytical errors. In contrast, incorrect handling of referred specimens and inadequate staff training or competency issues both obtained the lowest weighted mean (WM = 2.28), ranked nineteenth, and were interpreted as **Low Occurrence**, indicating that these were the least encountered errors among the respondents.

These findings support the studies of Gao, J. (2020), Lippi, G. and Favaloro, E. J. (2020), which identified hemolysis, specimen mishandling, and collection issues as common pre-analytical errors affecting laboratory accuracy. Similarly, Plebani, M. (2021) emphasized that insufficient specimen volume and documentation errors may compromise test reliability and delay laboratory procedures. In contrast, Alshammari, F. et al. (2021) noted that procedural knowledge gaps may also contribute to these errors.

Overall, the findings indicate that although pre-analytical laboratory errors occurred at a generally low level, specimen quality, adequacy, and documentation issues remain important concerns that require continuous training, supervision, and adherence to proper laboratory procedures.

DISCUSSION

The findings of the study indicate that Medical Technology interns possess strong theoretical understanding regarding pre-analytical laboratory errors. Their very high awareness level may be attributed to formal classroom instruction, laboratory coursework, review of standard operating procedures, and supervision during internship rotations. Awareness is a positive indicator because recognition of errors is the first step toward prevention (Gao, 2020).

Similarly, the high level of practices suggests that respondents generally follow proper laboratory standards in specimen collection and handling. This implies that most interns are capable of translating theoretical knowledge into practical application within clinical settings.

However, the moderate occurrence of selected errors reveals that knowledge alone does not completely eliminate mistakes. Factors such as workload pressure, fatigue, time constraints, unfamiliar hospital systems, communication barriers, and anxiety may contribute to lapses in performance. Lippi and Favaloro (2020) emphasized that the pre-analytical phase is highly influenced by human performance, where even minor errors or lapses may compromise specimen quality and affect patient results.

These findings support previous studies emphasizing that the pre-analytical stage remains the most error-prone component of total laboratory testing. According to Plebani (2021), continuous reinforcement of quality assurance practices and competency development is necessary to minimize pre-analytical laboratory errors and improve patient safety.

STUDY LIMITATIONS

This study was limited to Medical Technology interns from a single institution, which may restrict the generalizability of the findings to other schools or clinical training settings. The study also relied on self-reported responses gathered through questionnaires; therefore, the answers may have been influenced by response bias, overestimation of practices, or the respondents' desire to provide socially acceptable answers. In addition, the study focused only on the awareness, practices, and encountered pre-analytical laboratory errors during the period of data collection and did not include direct observation of actual laboratory performance. Variations in hospital assignments, laboratory workload, supervision, and exposure to different laboratory sections may have also affected the respondents' experiences and practices regarding pre-analytical procedures.

RECOMMENDATIONS

Based on the findings of the study, it is recommended that educational institutions and affiliated clinical laboratories continue strengthening competency-based training on pre-analytical laboratory procedures, particularly in specimen collection, handling, labeling, documentation, and adherence to standard operating procedures. Continuous supervision, monitoring, and immediate feedback from clinical instructors and laboratory staff may help reinforce proper laboratory practices and minimize pre-analytical errors among interns. Moreover, maintaining effective quality assurance and error-reporting systems may further improve

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laboratory reliability and patient safety. Future researchers are encouraged to conduct similar studies involving multiple institutions and broader methods of assessment to obtain more comprehensive findings regarding the experiences and practices of Medical Technology interns during clinical internship.

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