Clin. Lab. 2026;72:XXX-XXX

SHORT COMMUNICATION

Retrospective Review of Specimen Rejections in 2024: Insights from a Regional Hospital Laboratory

Yun-Jin Yang [1, *], Yi-Lin Yang [2, *], Tze-Kiong Er [1, 3]

[*] *Yun-Jin Yang and Yi-Lin Yang contributed equally to this article*
[1] *Division of Laboratory Medicine, Asia University Hospital, Asia University, Taichung, Taiwan*
[2] *Department of Nursing, Asia University Hospital, Asia University, Taichung, Taiwan*
[3] *Department of Medical Laboratory Science and Biotechnology, Asia University, Taichung, Taiwan*

ABSTRACT

Background: **Specimen rejection is a critical quality indicator in clinical laboratories, often resulting from pre-analytical errors that compromise diagnostic accuracy and patient care. This retrospective study analyzed rejection patterns at a regional hospital laboratory throughout 2024 to identify leading causes and guide quality improvement strategies.**
Methods: **Rejection data from January to December 2024 were retrieved from the laboratory information system and categorized by documented rejection reasons. Descriptive statistics were used to determine the frequency and proportion of each category. A chi-squared test was performed to evaluate monthly variation in the top three rejection causes.**
Results: **A total of 2,976 specimens were rejected during the 12-month period. The leading causes were severe hemolysis (37.67%), clotted specimen (20.40%), and insufficient specimen (8.70%). Together, the top 10 reasons accounted for approximately 88.3% of all rejections. The chi-squared test showed a statistically significant difference in the monthly distribution of the top three rejection causes ($\chi^2 = 44.95$, df = 24, p = 0.0059), suggesting that the variation over time was unlikely to be due to chance.**
Conclusions: **Pre-analytical errors remained the predominant contributors to specimen rejection in 2024. The observed fluctuations across months underscore the need for targeted interventions, such as staff retraining, reinforced specimen handling protocols, and enhanced communication between clinical and laboratory teams, to improve laboratory efficiency and patient safety.**
(Clin. Lab. 2026;72:xx-xx. DOI: 10.7754/Clin.Lab.2025.250812)

Correspondence:
Tze-Kiong Er, PhD
Division of Laboratory Medicine
Asia University Hospital
No. 222, Fuxin Rd.
Wufeng Dist., Taichung City 413
Taiwan
Phone: +886 4-37061668 ext. 1297
Email: tzekiong92@gmail.com
ORCID ID: https://orcid.org/0000-0002-7068-1652

Short Communication accepted August 13, 2025

KEYWORDS

specimen rejection, laboratory quality, hemolysis, clotted specimen, pre-analytical error, quality improvement

INTRODUCTION

High-quality clinical laboratory testing begins with proper specimen collection, handling, and processing. When specimens do not meet acceptance criteria, they are rejected, resulting in diagnostic delays, increased healthcare costs, and potentially compromised patient outcomes. A significant proportion of laboratory errors originate outside the analytical phase, with the pre-analytical stage being the most vulnerable. Studies report

that 46 - 68% of diagnostic errors occur before analysis, and an additional 18 - 47% arise post-analysis. In contrast, only 7 - 13% of total errors occur during the analytical phase [1]. Contributing factors to pre-analytical errors include ineffective communication among physicians, nurses, and phlebotomists, as well as poorly designed workflows for test ordering and specimen handling [2].

Given the high error rate in the pre-analytical phase, specimen rejection rates have become a key indicator of laboratory performance and quality assurance. To improve diagnostic accuracy and support patient-centered care, efforts must focus on enhancing sample quality through standardized procedures, comprehensive staff training, and closer collaboration between laboratory and clinical personnel [2,3]. According to Carraro et al., the most frequent pre-analytical issues include absent samples or test orders, patient misidentification, contamination from infusion lines, hemolysis, clotting, insufficient sample volume, incorrect container use, improper anticoagulant ratios, and inadequate specimen handling or transport conditions [4].

Therefore, identifying the causes of specimen rejection enables laboratories to uncover workflow deficiencies and implement targeted corrective actions. This study presents a retrospective analysis of the leading causes of unacceptable specimens in our regional hospital laboratory during 2024, providing insights into pre-analytical quality issues and informing future improvement strategies.

MATERIALS AND METHODS

Study design and setting

A retrospective review was conducted on all rejected specimens received by the medical laboratory at Asia University Hospital from January 1 to December 31, 2024. Rejection data were extracted from the laboratory information system (LIS), including the documented reason for each rejection. The ten most frequent causes were identified and ranked based on their frequency of occurrence. Descriptive statistics were applied to calculate the number and percentage of each rejection category relative to the total number of rejected specimens.

Data analysis

A chi-squared test was conducted to analyze temporal trends and determine whether the distribution of the top three rejection reasons (severe hemolysis, clotted specimen, and insufficient specimen) varied significantly across months. The analysis was performed using IBM SPSS Statistics for Windows, Version 31.0 (IBM SPSS Statistics for Windows; IBM Corp., Armonk, NY, USA). A p-value < 0.05 was considered statistically significant.

RESULTS

During the 12-month period in 2024, a total of 2,976 specimens were rejected. The top 10 rejection reasons are summarized in Table 1 and visually presented in Figure 1. Among them, severe hemolysis and clotted specimens together accounted for more than 58% of all rejections, underscoring their dominant contribution to pre-analytical quality issues. Collectively, the top 10 rejection causes accounted for 2,629 cases (88.3%), while the remaining 347 cases (11.7%) were attributed to less frequent or uncategorized errors. These results emphasize the importance of continuous surveillance and targeted interventions throughout the pre-analytical workflow, including those aimed at mitigating rare error types.

To further explore temporal variation in rejection patterns, monthly trends for the top three rejection causes, severe hemolysis, clotted specimen, and insufficient specimen, were analyzed. As illustrated in Figure 2, severe hemolysis consistently ranked as the most frequent cause of specimen rejection throughout 2024, with notable peaks observed in June (134 cases) and July (113 cases). Both clotted specimen and insufficient specimen also exhibited considerable month-to-month variability, reflecting persistent challenges in phlebotomy practices and pre-analytical quality control.

To assess whether these observed fluctuations were statistically significant, a chi-squared test was performed using IBM SPSS Statistics for Windows, Version 31.0 (IBM SPSS Statistics for Windows; IBM Corp., Armonk, NY, USA). The test was based on a contingency table comprising monthly frequencies of the three leading rejection causes. The results indicated a statistically significant difference in their distribution across the 12 months ($\chi^2 = 44.95$, df = 24, $p = 0.0059$), suggesting that these variations were unlikely to be due to random chance. These findings further highlight inconsistencies in pre-analytical procedures and reinforce the need for targeted quality improvement measures, particularly during months with elevated rejection rates.

DISCUSSION

We conducted a one-year retrospective review to evaluate trends in specimen rejection and identify the leading causes of pre-analytical errors in our laboratory. The findings confirm that pre-analytical issues remain the primary contributors to specimen rejection in clinical practice. Among all causes, severe hemolysis was the most frequent, accounting for 37.67% of rejected specimens. This aligns with prior studies identifying that hemolysis is primarily influenced by blood collection techniques but may also result from improper specimen handling, such as incorrect collection, inadequate storage conditions, or suboptimal processing procedures [5]. Similarly, a four-year study by Mesganaw B et al. in Ethiopia reported a 1.57% overall specimen rejection

Table 1. Top 10 rejection reasons in 2024.

Rank	Rejection Reason	Cases	Percentage (%)
1	Severe Hemolysis	1,121	37.67%
2	Clotted Specimen	607	20.40%
3	Insufficient Specimen	259	8.70%
4	Other Reasons	213	7.16%
5	Duplicate Medical Orders	124	4.17%
6	Incorrect Container	115	3.86%
7	Improper Specimen-to-Anticoagulant Ratio	68	2.28%
8	Specimen Leakage	57	1.92%
9	Cancelled Test Requiring Reorder	34	1.14%
10	Incorrect Specimen Category	31	1.04%

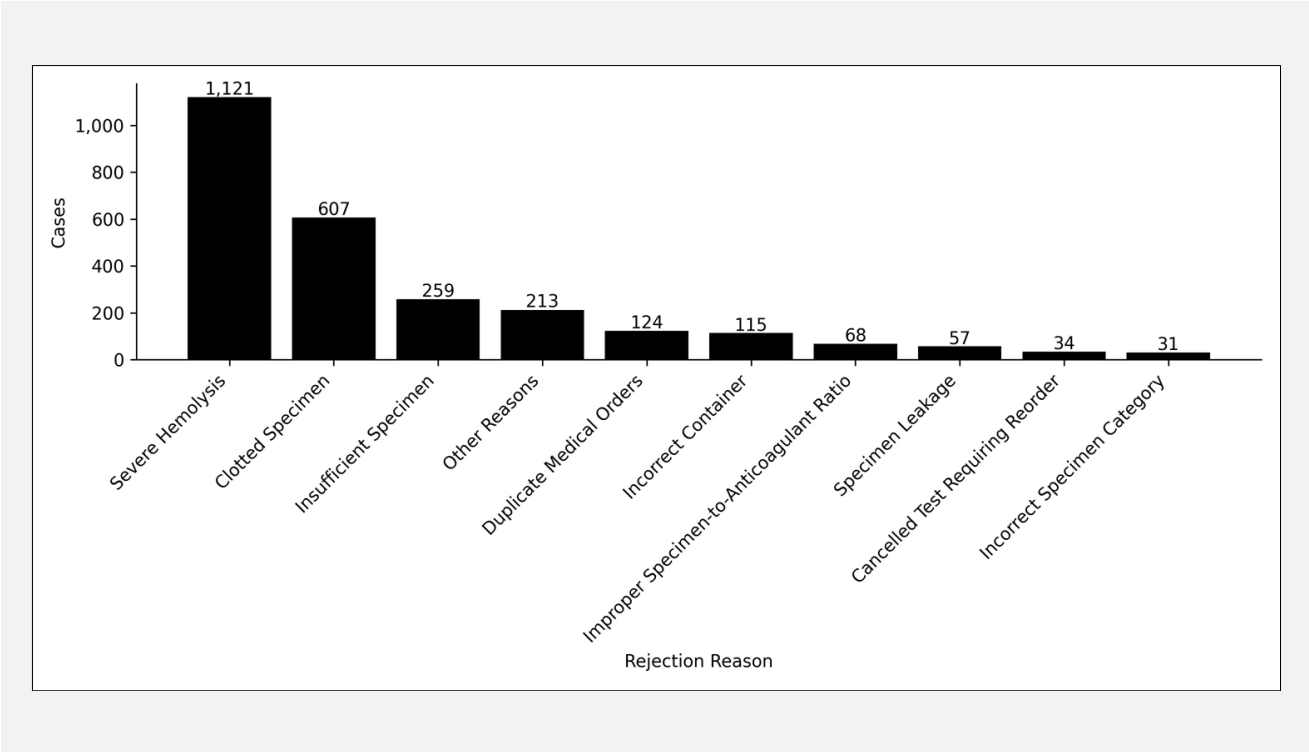

Figure 1. Distribution of the top 10 specimen rejection reasons in 2024.

Bar chart illustrating the frequency of the top 10 rejection causes out of 2,976 total rejected specimens at the medical laboratory of a regional hospital. Severe hemolysis (1,121 cases) and clotted specimen (607 cases) were the leading causes, together accounting for over 58% of all rejections. Each bar represents the number of rejected specimens per category, highlighting the predominance of preventable pre-analytical errors.

rate, with hemolysis and insufficient volume being the predominant causes [6]. These findings highlight the importance of regular phlebotomy retraining, strict adherence to standardized operating procedures (SOPs), and continuous quality monitoring to reduce hemolysis-related rejections.

Clotted specimen was the second most prevalent cause of rejection in our study, accounting for 20.40% of all rejected specimens. This issue often arises from inadequate mixing of anticoagulated tubes, delayed specimen transport, or incorrect tube selection. In high-pressure clinical environments, such as emergency departments,

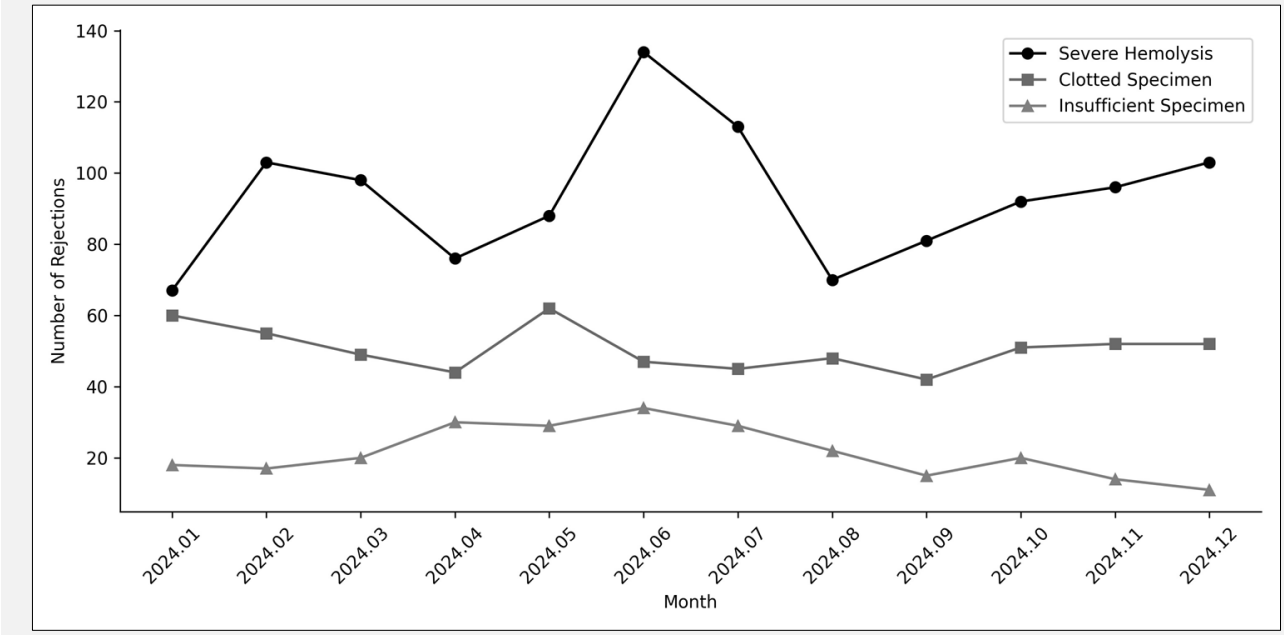

Figure 2. Monthly trends of the top three specimen rejection causes in 2024.

This line chart illustrates the monthly counts of the three most common pre-analytical rejection reasons, severe hemolysis, clotted specimen, and insufficient specimen, recorded at the central laboratory throughout 2024. Severe hemolysis was the predominant issue across all months, peaking in June (134 cases) and July (113 cases). Both clotted specimen and insufficient specimen also displayed temporal fluctuations, reflecting possible variability in blood collection techniques and adherence to pre-analytical protocols.

factors like frequent staff turnover, limited training, and inconsistent adherence to specimen handling protocols may further contribute to this problem. Similarly, a study by Jafari et al. involving 104,008 laboratory specimens in an Iranian hospital reported a 2.21% specimen rejection rate, with clotting, hemolysis, and insufficient volume identified as the leading causes. These findings underscore the need for continuous staff training and root cause analysis to address pre-analytical vulnerabilities [7]. Targeted interventions, such as competency-based education, workflow audits, and real-time feedback mechanisms, may be effective in reducing this preventable source of error.

Insufficient specimen accounted for 8.70% of all rejected specimens, often resulting from noncompliance with minimum volume requirements or challenges such as difficult venous access. Atay et al. similarly reported that insufficient specimen, particularly in coagulation tests, along with unclear test requests and improper labeling, were key contributors to pre-analytical errors [8]. Inadequate filling can significantly compromise test accuracy, especially in coagulation and chemistry assays. Addressing this issue requires training programs that stress adherence to tube fill lines and the implementation of real-time feedback mechanisms to reinforce best practices and reduce recurrence.

Other notable causes, such as duplicate medical orders (4.17%), incorrect containers (3.86%), and specimen leakage (1.92%), reflect systemic vulnerabilities within the pre-analytical phase. These issues may be mitigated by enhancing LIS-based order entry validation, reinforcing accurate sample labeling practices, and ensuring secure and compliant specimen packaging during transport. Targeted quality improvement initiatives in these areas can contribute to a more robust and error-resistant specimen handling process.

Although their percentages were lower, issues such as improper specimen-to-anticoagulant ratios (2.28%), cancelled test reorders (1.14%), and specimen misclassification (1.04%) still warrant attention, particularly in teaching hospitals where frequent staff rotations and trainee involvement may increase the risk of pre-analytical errors. Proactive supervision, standardized checklists, and routine competency assessments can help mitigate these risks in high-turnover environments.

Based on these findings, several targeted interventions are recommended to address the most common causes of specimen rejection. Refresher training programs should be provided for clinical and phlebotomy staff, with particular emphasis on proper techniques to pre-

vent hemolysis and ensure adequate mixing of blood samples. Visual aids should be placed at blood collection stations to reinforce correct tube handling and mixing procedures. In addition, implementing monthly rejection dashboards can help clinical departments track their performance and identify areas for improvement. Integrating alert systems within the LIS to detect duplicate orders and ensure specimen-container compatibility can further reduce errors. Regular internal audits focusing on rejection documentation and trend analysis will support continuous quality monitoring. These data-driven interventions are consistent with international quality improvement standards and are anticipated to contribute to a sustained reduction in specimen rejection rates over time.

This retrospective analysis of 2,976 rejected specimens in 2024 revealed that the majority of rejections stemmed from preventable pre-analytical errors, with hemolysis and clotted specimens being the most prominent. These findings underscore the critical need for targeted staff training, strict adherence to standard operating procedures, and strengthened interdepartmental collaboration. Implementing these measures is vital to reducing rejection rates, improving laboratory efficiency, and ultimately enhancing patient safety and care quality.

Acknowledgment:
This study was supported by grants from Asia University Hospital (ASIA-114-51018).

Declaration of Interest:
There are no conflicts of interest associated with this paper.

References:

1. Cornes MP, Atherton J, Pourmahram G, et al. Monitoring and reporting of preanalytical errors in laboratory medicine: the UK situation. Ann Clin Biochem 2016;53(Pt 2):279-84. (PMID: 26195485)

2. Plebani M. Errors in clinical laboratories or errors in laboratory medicine? Clin Chem Lab Med 2006;44(6):750-9. (PMID: 16729864)

3. Nordin N, Ab Rahim SN, Wan Omar WFA, et al. Preanalytical Errors in Clinical Laboratory Testing at a Glance: Source and Control Measures. Cureus 2024;16(3):e57243. (PMID: 38559530)

4. Carraro P, Plebani M. Errors in a stat laboratory: types and frequencies 10 years later. Clin Chem 2007;53(7):1338-42. (PMID: 17525103)

5. Lippi G, Chance JJ, Church S, et al. Preanalytical quality improvement: from dream to reality. Clin Chem Lab Med 2011;49 (7):1113-26. (PMID: 21517699)

6. Mesganaw B, Misganaw K, Belayneh M. Trends and determinants of laboratory specimen rejection rates at Debre Markos comprehensive specialized hospital in Ethiopia. Sci Rep 2025;15 (1):25823. (PMID: 40670473)

7. Jafari E, Malekpour Afshar R, Aminzade R. Rates and Reasons of Laboratory Sample Rejection due to Pre-analytical Errors in Clinical Settings. Arch Iran Med 2022;25(3):166-70. (PMID: 35429958)

8. Atay A, Demir L, Cuhadar S, et al. Clinical biochemistry laboratory rejection rates due to various types of preanalytical errors. Biochem Med (Zagreb) 2014;24(3):376-82. (PMID: 25351356)