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College of Management

Department: Master of Health Administration



Title:

**Assessment of the Causes of Laboratory Specimen Rejection in a
Tertiary Care Hospital**

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Abstract

Laboratory testing plays a crucial role in clinical decision-making, and the accuracy of laboratory results largely depends on the quality of collected specimens. Errors occurring during the pre-analytical phase remain one of the most frequent challenges faced by clinical laboratories worldwide. Among these errors, specimen rejection represents an important quality indicator because it may delay diagnosis, increase laboratory workload, and require recollection of samples from patients.

This study aimed to analyze the causes of specimen rejection in a tertiary care hospital laboratory and to identify operational factors associated with pre-analytical errors. A retrospective cross-sectional study was conducted using laboratory rejection records from July to December 2025. A total of **1,240 rejected specimens** were analyzed. Data were examined to determine rejection patterns by month, department, reason for rejection, and collector experience level.

The findings indicated that hemolyzed specimens represented the most frequent cause of rejection, followed by clotted samples and insufficient specimen volume. Rejected samples were observed across multiple hospital departments, particularly in emergency and intensive care units. Additionally, the results suggested that newly recruited staff were associated with higher rejection frequencies compared with more experienced personnel.

The study highlights the importance of improving specimen collection practices, strengthening staff training programs, and implementing continuous monitoring of specimen rejection trends in hospital laboratories.

Keywords:

Laboratory testing, Specimen rejection, Pre-analytical errors, Hemolysis, Tertiary care hospital, Quality indicators, Staff experience, Laboratory quality.

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List of terminology

Term	Definition
Pre-analytical phase	All procedures before laboratory analysis including collection and handling
Specimen rejection	Refusal of a sample that does not meet laboratory criteria
Hemolysis	Breakdown of red blood cells affecting sample integrity
Clotted sample	Blood sample that coagulated due to improper mixing
QNS	Quantity Not Sufficient for analysis
Quality indicator	Measure used to monitor laboratory performance

List of abbreviations

Abbreviation	Meaning
ER	Emergency Room
ICU	Intensive Care Unit
NICU	Neonatal Intensive Care Unit
LDR	Labor and Delivery Room
OPD	Outpatient Department
QNS	Quantity Not Sufficient
LIS	Laboratory Information System

Chapter 1: Introduction

1.1 Introduction

Clinical laboratory services play a fundamental role in modern healthcare systems by providing essential diagnostic information that supports clinical decision-making. Laboratory test results are widely used in disease diagnosis, treatment planning, monitoring of patient progress, and evaluation of therapeutic outcomes. It has been estimated that a significant proportion of medical decisions are influenced by laboratory findings, which highlights the importance of ensuring the accuracy and reliability of laboratory results (Lundberg, 1981).

The laboratory testing process is typically divided into three main phases: the pre-analytical phase, the analytical phase, and the post-analytical phase. Among these stages, the **pre-analytical phase** is recognized as the most complex and error-prone component of the testing process. This phase includes all procedures that occur before the actual laboratory analysis, such as patient preparation, specimen collection, labeling, transportation, and storage (Plebani, 2010).

Errors occurring during the pre-analytical phase can significantly affect the quality of laboratory results. In many cases, these errors may lead to specimen rejection, which occurs when a collected sample does not meet the laboratory's acceptance criteria and cannot be processed for analysis. Specimen rejection represents a critical issue in laboratory medicine because it may result in delays in diagnosis, increased workload for laboratory and clinical staff, additional costs, and inconvenience or discomfort for patients who must undergo repeated specimen collection.

In tertiary care hospitals, where patient volume is high and clinical cases are often complex, the risk of pre-analytical errors may be even greater. Specimen collection is performed across multiple departments, including emergency units, intensive care units, inpatient wards, and outpatient clinics. These settings often involve time-sensitive situations, critically ill patients, and high-pressure environments, all of which may contribute to variability in specimen collection practices and increase the likelihood of errors.

Among the various causes of specimen rejection, hemolysis has been consistently reported as the most common factor affecting blood sample quality (Simundic, 2014). Hemolysis occurs when red blood cells rupture, releasing intracellular contents into the plasma or serum, which can interfere with laboratory measurements and compromise result accuracy. Other common causes of specimen rejection include clotted samples, insufficient specimen volume, incorrect collection containers, labeling errors, and improper specimen handling during transportation.

Another important factor that may influence specimen rejection is the experience level of healthcare staff responsible for specimen collection. In hospital settings, particularly in large tertiary institutions, there is often a continuous influx of newly recruited staff due to workforce turnover. Newly joined staff may require time to become familiar with standard

specimen collection procedures, which may increase the likelihood of pre-analytical errors if adequate training and supervision are not provided.

Monitoring specimen rejection rates is widely recognized as an important quality indicator in laboratory medicine (Plebani, 2012) (Plebani, 2012). By analyzing the causes and patterns of rejected specimens, laboratories can identify weaknesses in the pre-analytical process and implement targeted interventions to improve specimen quality. Such interventions may include staff training programs, standardization of collection procedures, improved communication between laboratory and clinical departments, and enhanced monitoring systems.

Despite the importance of this issue, many healthcare institutions do not conduct detailed analysis of specimen rejection patterns within their laboratories. Understanding the underlying causes of specimen rejection in a specific hospital setting can provide valuable insights into operational challenges and help guide quality improvement efforts.

This study aims to evaluate the causes of laboratory specimen rejection in a tertiary care hospital over a six-month period. The study also explores the relationship between specimen rejection and collector experience level, in order to assess whether staff training and workforce dynamics may influence specimen quality. By identifying the most common causes of rejection and analyzing patterns across departments and staff categories, this research seeks to contribute to the improvement of laboratory practices and enhance the overall quality of healthcare services.

1.2 Research Problem

Despite the critical role of laboratory testing in clinical decision-making, specimen rejection remains a persistent challenge in many hospital laboratories. Rejected specimens can lead to delays in reporting results, increased workload for healthcare staff, additional costs, and inconvenience for patients who must undergo repeated sample collection.

In tertiary care hospitals, where large volumes of specimens are processed daily and clinical conditions are often complex, the likelihood of pre-analytical errors may increase. Specimen collection is performed across multiple departments by different healthcare professionals, often under time pressure and varying levels of experience. These factors may contribute to inconsistencies in specimen collection practices and increase the risk of specimen rejection.

Although specimen rejection is recognized as an important quality indicator, many laboratories do not perform detailed analysis of rejection patterns or investigate the underlying causes. Without such analysis, it becomes difficult to implement targeted quality improvement measures.

Therefore, this study seeks to address the problem of specimen rejection by analyzing its causes and identifying factors that may contribute to pre-analytical errors within a tertiary care hospital setting.

1.3 Research Questions

This study aims to answer the following research questions:

1. What are the most common causes of laboratory specimen rejection in the hospital?
 2. How are rejected specimens distributed across different hospital departments?
 3. What is the pattern of specimen rejection over time during the study period?
 4. Does the experience level of healthcare staff collecting specimens influence rejection rates?
 5. What operational factors may contribute to pre-analytical errors in specimen collection?
-

1.4 Research Objectives

General Objective:

To evaluate the causes of laboratory specimen rejection in a tertiary care hospital.

Specific Objectives:

1. To determine the monthly distribution of rejected specimens.
 2. To identify the most frequent causes of specimen rejection.
 3. To analyze the distribution of rejected specimens across hospital departments.
 4. To assess the relationship between collector experience level and specimen rejection.
 5. To identify potential operational factors contributing to pre-analytical errors.
 6. To provide recommendations for improving specimen collection practices and reducing rejection rates.
-

1.5 Research Hypotheses

The study is based on the following hypotheses:

H1: Hemolyzed specimens represent the most frequent cause of specimen rejection in the hospital laboratory.

H2: Hospital departments with higher patient volume demonstrate higher specimen rejection rates.

H3: Specimens collected by newly recruited staff have higher rejection rates compared with those collected by more experienced staff.

H4: Pre-analytical errors are the primary contributors to specimen rejection in the laboratory.

1.6 Importance of the Study

This study is important because it provides a detailed analysis of specimen rejection patterns in a tertiary care hospital laboratory. By identifying the most common causes of specimen rejection, the study contributes to improving laboratory quality and patient care.

The findings of this research may help laboratory managers and healthcare professionals better understand the factors affecting specimen quality and implement appropriate corrective measures. In addition, the study highlights the role of staff experience in specimen collection, which may support the development of targeted training programs.

Furthermore, this research adds to the existing body of knowledge in laboratory medicine by providing data from a real hospital setting, which may be useful for future studies and quality improvement initiatives.

1.7 Study Limitations

This study has several limitations that should be considered when interpreting the results.

First, the study is based on retrospective data obtained from laboratory rejection records, which may not capture all possible factors influencing specimen rejection. Second, the study was conducted in a single tertiary care hospital, which may limit the generalizability of the findings to other healthcare settings.

Additionally, the study focuses primarily on descriptive statistical analysis, and more advanced analytical methods could provide deeper insights into the relationships between different variables.

1.8 Study Scope

This study focuses on laboratory specimen rejection within a tertiary care hospital over a six-month period from July to December 2025. The analysis includes rejected specimens recorded in laboratory records and examines variables such as department, reason for rejection, and collector experience level.

The study is limited to pre-analytical errors and does not include errors occurring during the analytical or post-analytical phases of laboratory testing.

Chapter 2: Literature Review

2.1 Introduction

The accuracy and reliability of laboratory test results are essential for effective clinical decision-making. Laboratory medicine plays a central role in modern healthcare, influencing diagnosis, treatment, and patient monitoring. However, the quality of laboratory results depends not only on the analytical phase but also on the processes that occur before analysis, commonly referred to as the pre-analytical phase.

The pre-analytical phase includes patient preparation, specimen collection, labeling, transportation, and storage. Errors occurring during this stage may compromise specimen quality and lead to incorrect or delayed laboratory results. Among the various consequences of pre-analytical errors, specimen rejection is one of the most significant indicators of laboratory quality (Plebani, 2010).

This chapter reviews the existing literature on pre-analytical errors, specimen rejection, and factors influencing specimen quality in hospital laboratories.

2.2 Pre-Analytical Errors in Laboratory Medicine

Pre-analytical errors are widely recognized as the most frequent source of laboratory testing inaccuracies. According to Lippi et al. (2012), approximately 60–70% of laboratory errors occur during the pre-analytical phase. These errors are often related to specimen collection, handling, and transportation.

Similarly, Plebani (2010) emphasized that pre-analytical errors represent a major challenge in laboratory quality management. These errors may arise from improper patient identification, incorrect specimen collection techniques, inadequate labeling, and delays in specimen transport.

Pre-analytical errors are particularly important because they occur outside the laboratory environment, often involving multiple healthcare professionals. As a result, controlling these errors requires coordination between laboratory staff and clinical departments (Simundic, 2014).

2.3 Specimen Rejection as a Quality Indicator

Specimen rejection is considered a key quality indicator in laboratory medicine. It reflects the effectiveness of specimen collection and handling processes. High rejection rates may indicate weaknesses in pre-analytical procedures and highlight areas requiring improvement (Plebani, 2012).

According to Carraro and Plebani (2007), monitoring specimen rejection allows laboratories to identify common errors and implement corrective actions. These actions

may include staff training, process standardization, and improved communication between departments.

Furthermore, specimen rejection has direct implications for patient care. Rejected samples often require recollection, which may delay diagnosis and treatment while increasing patient discomfort and healthcare costs (Green, 2013).

2.4 Hemolysis as the Leading Cause of Specimen Rejection

Hemolysis is one of the most frequently reported causes of specimen rejection in clinical laboratories. Hemolysis occurs when red blood cells rupture, releasing intracellular contents into the plasma or serum, which can interfere with laboratory test results.

Simundic (2014) reported that hemolysis is the most common pre-analytical error in blood samples. Factors contributing to hemolysis include improper venipuncture technique, use of small-gauge needles, excessive suction during blood collection, prolonged tourniquet application, and improper specimen handling during transport.

Studies have also shown that hemolysis rates are higher in emergency departments due to the urgent nature of specimen collection and challenging patient conditions (Lippi et al., 2012). This is particularly relevant in tertiary care hospitals where emergency and critical care services are frequently utilized.

2.5 Other Causes of Specimen Rejection

In addition to hemolysis, several other factors contribute to specimen rejection. Clotted samples are a common issue, especially in tests requiring anticoagulated blood. Clotting may occur when blood samples are not mixed properly with anticoagulant tubes after collection (Plebani, 2010).

Insufficient specimen volume, often referred to as QNS (Quantity Not Sufficient), is another frequent cause of rejection. This may occur when collectors encounter difficulty obtaining adequate blood volume, particularly in pediatric or critically ill patients (Agarwal et al., 2017).

Incorrect tube selection is also a significant pre-analytical error. Different laboratory tests require specific collection tubes with appropriate additives. Using the wrong tube may render the specimen unsuitable for analysis (Clinical and Laboratory Standards Institute [CLSI], 2010).

Labeling errors, including unlabeled or mislabeled specimens, represent a serious issue in laboratory practice. These errors can compromise patient safety and lead to incorrect test results if not detected (Jones et al., 1997).

2.6 Impact of Staff Training and Experience

Healthcare professionals responsible for specimen collection play a crucial role in ensuring specimen quality. Several studies have highlighted the importance of staff training in reducing pre-analytical errors.

According to Green (2013), inadequate training and lack of adherence to standardized procedures are major contributors to specimen rejection. Newly recruited staff may be particularly vulnerable to errors due to limited experience and unfamiliarity with laboratory protocols.

In hospitals with high staff turnover, maintaining consistent specimen collection practices can be challenging. Continuous education and supervision are therefore essential to ensure that all healthcare staff follow proper procedures (World Health Organization [WHO], 2011).

2.7 Influence of Hospital Environment

The hospital environment itself may influence specimen rejection rates. Tertiary care hospitals typically handle large patient volumes and complex clinical cases. These conditions may increase the likelihood of pre-analytical errors.

Departments such as emergency units and intensive care units are particularly prone to specimen rejection due to the urgency of patient care and the need for rapid specimen collection. Time constraints and workload pressures may affect adherence to standard procedures (Lippi et al., 2012).

2.8 Strategies for Reducing Specimen Rejection

Several strategies have been proposed to reduce specimen rejection rates in clinical laboratories. These include:

- implementing standardized specimen collection protocols
- providing regular training and competency assessments for healthcare staff
- improving communication between laboratory and clinical departments
- using automated systems to detect pre-analytical errors
- monitoring quality indicators such as rejection rates

According to the International Organization for Standardization (ISO, 2012), continuous quality improvement is essential for maintaining laboratory performance.

2.9 Summary of Literature

The reviewed literature demonstrates that pre-analytical errors are the primary source of laboratory testing inaccuracies, with hemolysis being the most common cause of specimen

rejection (Simundic, 2014). Other important factors include clotting, insufficient specimen volume, incorrect tube selection, and labeling errors (Plebani, 2010).

Staff training, experience, and hospital workload have also been identified as key factors influencing specimen quality (Green, 2013). These findings highlight the importance of monitoring specimen rejection as a quality indicator and implementing targeted interventions to reduce errors.

Chapter 3: Research Methodology

3.1 Introduction

This chapter outlines the methodological framework of the study, including the research design, study setting, study population, data collection procedures, variables, and methods of data analysis. It also addresses ethical considerations and study limitations. The aim of this chapter is to provide a clear and systematic description of how the research was conducted to ensure the validity, transparency, and reproducibility of the findings.

3.2 Research Design

This study employed a **retrospective cross-sectional research design**. The retrospective approach was selected as the study relied on previously recorded laboratory data related to specimen rejection. The cross-sectional design enabled the assessment of specimen rejection patterns over a defined time period.

This design is considered appropriate for descriptive and analytical purposes, as it allows the identification of trends, frequencies, and relationships among variables without any experimental intervention. The study was therefore observational in nature, focusing on existing data rather than manipulating or influencing study variables.

3.3 Study Setting

The study was conducted in the clinical laboratory of a **tertiary care hospital** that provides comprehensive diagnostic services to a wide range of clinical departments. These departments include:

- Emergency Department (ER)
- Intensive Care Unit (ICU)
- Neonatal Intensive Care Unit (NICU)
- Labor and Delivery Room (LDR)
- Post-Natal Ward
- Inpatient Medical and Surgical Wards
- Outpatient Clinics

As a tertiary care institution, the hospital manages a high volume of patients and complex clinical cases. This environment presents a suitable setting for evaluating pre-analytical errors and specimen rejection patterns under real clinical conditions.

3.4 Study Population

The study population consisted of all laboratory specimens that were rejected by the clinical laboratory during the study period.

Inclusion Criteria:

- All specimens recorded as rejected in laboratory records
- Specimens collected between **July and December 2025**

Exclusion Criteria:

- Specimens that were accepted and processed successfully
- Records with incomplete or missing key data

A total of **1,240 rejected specimens** met the inclusion criteria and were included in the analysis.

3.5 Data Collection

Data were collected retrospectively from laboratory rejection records documented in the laboratory information system. The data collection process involved systematic review and extraction of relevant variables for each rejected specimen.

The following variables were collected:

- Date of specimen collection
- Department requesting the test
- Reason for specimen rejection
- Type of rejected test
- Nurse identification number

To ensure confidentiality, all patient identifiers were excluded from the dataset. The collected data were organized and prepared for statistical analysis.

3.6 Study Variables

The study variables were categorized into independent and dependent variables as follows:

3.6.1 Independent Variables

- Department (e.g., ER, ICU, NICU, wards, outpatient clinics)
- Collector experience level
- Month of specimen collection

3.6.2 Dependent Variable

- Specimen rejection

3.6.3 Classification of Rejection Causes

Rejection reasons were grouped into standardized categories to facilitate analysis:

Sample Quality Errors

- Hemolyzed specimens
- Clotted samples
- Insufficient specimen volume

Collection Errors

- Incorrect collection container
- Under-filled tubes

Identification Errors

- Unlabeled specimens
- Mislabeled specimens

Handling and Transport Errors

- Improper storage temperature
- Delayed transport
- Specimen leakage

3.7 Collector Experience Classification

To evaluate the impact of staff experience on specimen rejection, collectors were categorized based on the first digit of their identification number.

This classification provided a practical method to assess the relationship between experience level and specimen rejection rates while maintaining staff anonymity.

3.8 Data Analysis

Data were analyzed using descriptive statistical methods. The analysis focused on identifying patterns and distributions within the dataset.

The following analyses were performed:

- Frequency distribution of rejected specimens

- Percentage calculation for each rejection category
- Monthly trend analysis of rejected specimens
- Distribution of rejection causes
- Comparison of rejected specimens across departments
- Analysis of rejection patterns based on collector experience level

The results were presented using structured tables and graphical representations, including bar charts and pie charts, to enhance clarity and interpretation.

3.9 Ethical Considerations

This study was conducted in accordance with ethical standards for research involving healthcare data. Patient confidentiality was strictly maintained by excluding all personal identifiers from the dataset.

The study utilized secondary data obtained from laboratory records and did not involve direct patient interaction. Approval to access and use the data was obtained from the relevant hospital authorities.

3.10 Study Limitations

Several limitations should be considered when interpreting the findings of this study.

First, the study relied on retrospective data, which may not capture all factors influencing specimen rejection. Second, the study was conducted in a single tertiary care hospital, which may limit the generalizability of the results to other healthcare settings.

Additionally, the analysis was primarily descriptive in nature. The use of more advanced statistical methods could provide deeper insight into the relationships between variables.

3.11 Summary

This chapter presented a detailed description of the research methodology, including the study design, setting, population, data collection procedures, and analytical approach. The use of a retrospective cross-sectional design enabled the evaluation of specimen rejection patterns using real-world laboratory data. The following chapter presents the results of the analysis.

Chapter 4: Results

4.1 Introduction

This chapter presents the findings of the study based on the analysis of **1,240 rejected specimens** collected between July and December 2025. The results are organized into four main sections: the monthly distribution of rejected specimens, the causes of specimen rejection, the distribution of rejected specimens across hospital departments, and the relationship between collector experience level and specimen rejection.

4.2 Monthly Distribution of Rejected Specimens

Table 4-1

Monthly Distribution of Rejected Samples

Month	Rejected Samples	Percentage (%)
July	238	19.2%
August	270	21.8%
September	186	15.0%
October	188	15.2%
November	157	12.7%
December	201	16.2%
Total	1240	100%

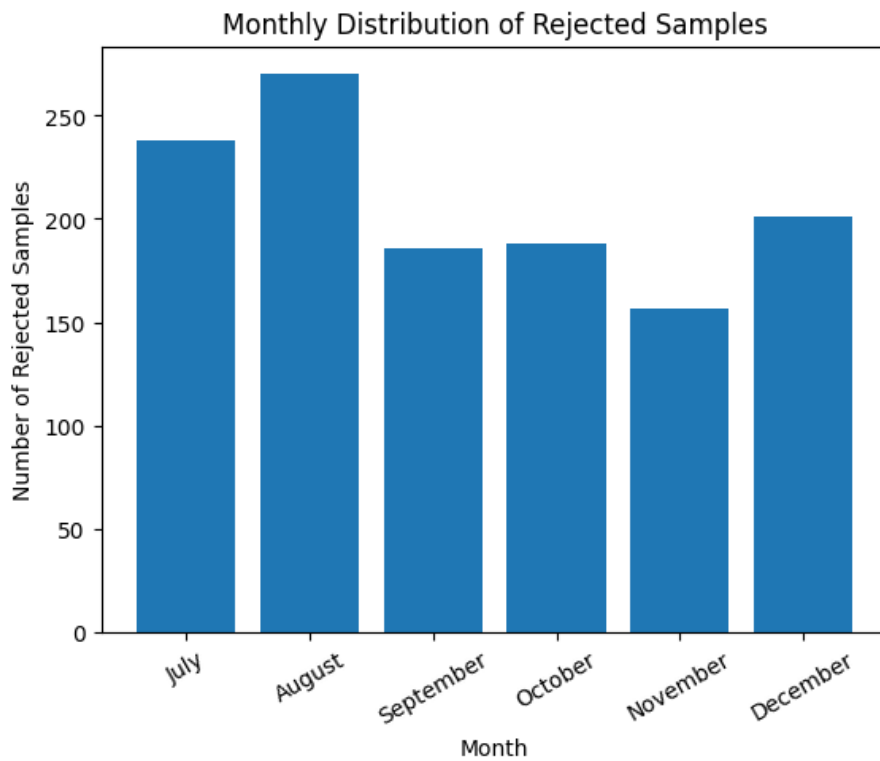


Figure 4-2: Causes of Specimen Rejection

Interpretation

The distribution of rejected specimens across the study period demonstrates noticeable variation between months. The highest number of rejected specimens was recorded in **August (21.8%)**, followed by **July (19.2%)**, while the lowest number was observed in **November (12.7%)**.

This variation may be attributed to fluctuations in patient volume, staffing patterns, and operational workload within the hospital. The relatively higher rejection rates during July and August may reflect increased clinical activity or the integration of newly recruited staff, which can influence specimen collection practices.

In contrast, the reduction observed in November may indicate improved adherence to specimen collection protocols or increased staff familiarity with procedures over time. These findings suggest that specimen rejection is influenced by both technical and operational factors.

4.3 Causes of Specimen Rejection

Table 4-2

Distribution of Rejection Causes

Cause of Rejection	Frequency	Percentage (%)
Hemolyzed samples	589	47.5%
Clotted samples	209	16.9%
Insufficient volume (QNS)	65	5.2%
Wrong collection container	84	6.8%
Temperature/handling errors	51	4.1%
Under-filled tubes	32	2.6%
Leakage/spillage	12	1.0%
Unspecified / unclear	198	16.0%
Total	1240	100%

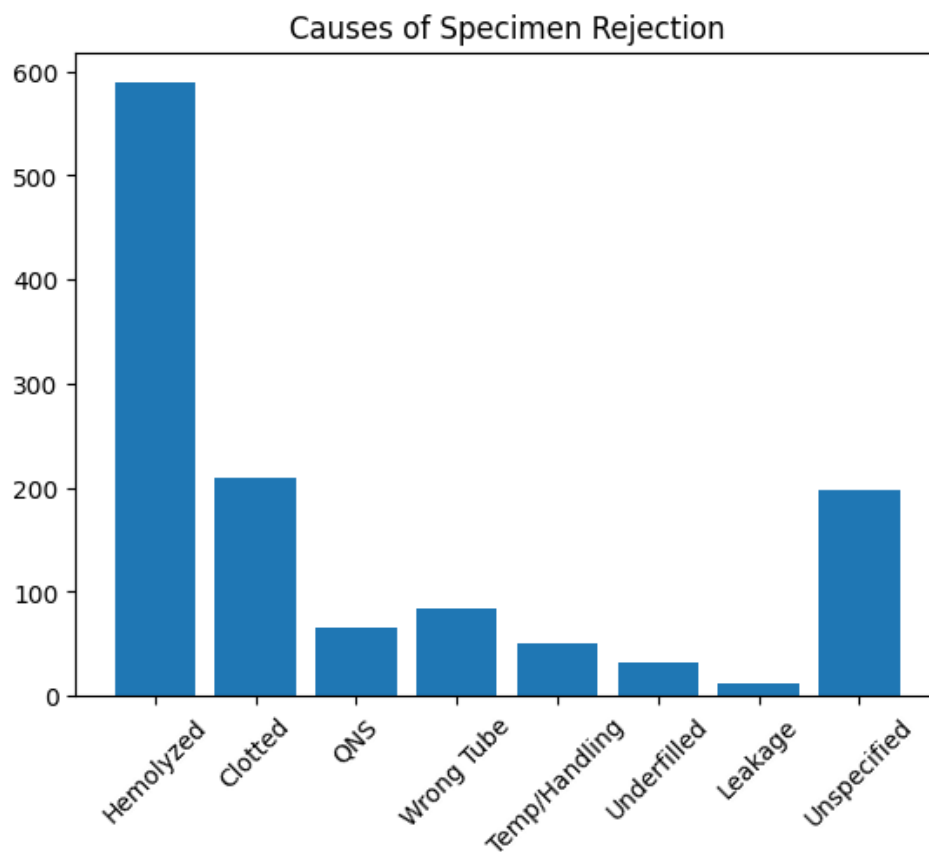


Figure 4-2: Causes of Specimen Rejection

Interpretation

The analysis of rejection causes indicates that **hemolyzed specimens were the most frequent cause (47.5%)**, accounting for nearly half of all rejected samples. This highlights

hemolysis as the primary pre-analytical challenge affecting specimen quality in the hospital.

The high rate of hemolysis may be associated with improper venipuncture techniques, excessive suction during blood collection, prolonged tourniquet application, or improper handling and transport of samples. These issues are more likely to occur in high-pressure clinical settings where rapid specimen collection is required.

Clotted samples represented the second most common cause (16.9%), suggesting possible inadequate mixing of blood with anticoagulants. Insufficient specimen volume (5.2%) reflects potential difficulties in sample collection, particularly in vulnerable patient groups.

Errors related to incorrect tube selection (6.8%) and handling or temperature issues (4.1%) further emphasize the importance of adherence to standardized procedures.

Additionally, the presence of a significant proportion of unspecified rejection reasons (16.0%) indicates gaps in documentation practices, which may limit accurate quality monitoring and should be addressed.

4.4 Distribution by Hospital Department

Table 4-3

Rejected Specimens by Department

Department	Rejected Samples	Percentage (%)
ICU	229	18.5%
ER	146	11.8%
Post Natal	130	10.5%
NICU	67	5.4%
OPD	65	5.2%
Medical Ward	65	5.2%
Telemetry	54	4.4%
LDR	53	4.3%
Others	431	34.7%
Total	1240	100%

Interpretation

The distribution of rejected specimens across hospital departments revealed that the **Intensive Care Unit (ICU)** had the highest proportion (18.5%), followed by the **Emergency Department (11.8%)** and **Post-Natal units (10.5%)**.

The high rejection rate in the ICU may be attributed to the critical condition of patients, frequent need for laboratory testing, and the urgency associated with clinical decision-making. These conditions may increase the likelihood of deviations from standard specimen collection procedures.

Similarly, the emergency department is characterized by high patient turnover and time-sensitive situations, which may contribute to increased pre-analytical errors.

The presence of rejected specimens across multiple departments indicates that specimen rejection is a system-wide issue rather than being confined to a single clinical area, emphasizing the need for comprehensive quality improvement strategies.

4.5 Specimen Rejection by Collector Experience

Table 4-4

Distribution by Experience Level

Experience Level	Rejected Samples	Percentage (%)
Level 1 (Highly experienced)	128	10.3%
Level 2 (Experienced)	272	21.9%
Level 3 (Moderate)	384	31.0%
Level 4+ (New staff)	456	36.8%
Total	1240	100%

Interpretation

The analysis of specimen rejection based on collector experience demonstrates a clear trend, with **newly recruited staff accounting for the highest proportion of rejected specimens (36.8%)**.

This finding suggests that limited experience and insufficient familiarity with specimen collection protocols may contribute to increased pre-analytical errors among new staff. Moderately experienced staff also showed relatively high rejection rates, indicating that skill development requires continuous practice and reinforcement.

In contrast, highly experienced staff had the lowest rejection rates, reflecting greater proficiency and adherence to standard procedures.

These results highlight the critical role of training, supervision, and competency assessment in improving specimen quality and reducing rejection rates.

4.6 Summary of Results

The findings of this study demonstrate that specimen rejection is predominantly driven by pre-analytical errors, with hemolysis being the most significant contributing factor. Rejection rates varied across months and departments, indicating the influence of operational and clinical conditions.

The analysis also revealed a strong association between collector experience and specimen rejection, with newly recruited staff contributing disproportionately to rejection rates.

Overall, these findings emphasize the need for targeted interventions focusing on staff training, adherence to standardized procedures, and improved documentation practices to enhance laboratory performance and patient care.

Chapter 5: Discussion

5.1 Introduction

This chapter discusses the findings of the study in relation to existing literature and provides an interpretation of the results within the context of laboratory practice in a tertiary care hospital. The discussion focuses on the main causes of specimen rejection, the influence of hospital departments, and the impact of collector experience on specimen quality.

5.2 Pre-Analytical Errors and Specimen Rejection

The findings of this study demonstrate that specimen rejection is primarily driven by errors occurring in the pre-analytical phase. This is consistent with previous research indicating that the majority of laboratory errors originate before the analytical process.

Studies in laboratory medicine have consistently reported that pre-analytical errors account for the largest proportion of laboratory inaccuracies (Lippi et al., 2012; Plebani, 2010). These errors are often related to specimen collection, handling, and transportation, all of which are influenced by human factors and operational conditions.

The results of this study reinforce the importance of focusing on pre-analytical processes as a key area for quality improvement in laboratory services.

5.3 Hemolysis as the Leading Cause of Rejection

The present study identified hemolysis as the most frequent cause of specimen rejection, accounting for nearly half of all rejected samples. This finding is consistent with previous studies, which have reported hemolysis as the most common pre-analytical error in clinical laboratories (Simundic, 2014).

Hemolysis typically occurs due to improper venipuncture techniques, excessive suction during blood collection, prolonged tourniquet application, or improper handling of specimens during transportation. These factors can be exacerbated in high-pressure environments such as emergency and critical care units.

The high proportion of hemolyzed specimens observed in this study highlights the need for improved training and standardization of specimen collection techniques, particularly in departments where rapid sample collection is required.

5.4 Clotted Samples and Insufficient Volume

Clotted samples were identified as the second most common cause of specimen rejection, followed by insufficient specimen volume. These findings are also consistent with previous studies, which have reported similar patterns in specimen rejection causes (Agarwal et al., 2017).

Clotting of samples is often associated with inadequate mixing of blood with anticoagulant tubes immediately after collection. This indicates potential gaps in adherence to standard procedures.

Insufficient specimen volume may reflect challenges in blood collection, particularly in patients with difficult venous access or in high-acuity clinical settings. These findings suggest that both technical skills and clinical conditions play a role in specimen quality.

5.5 Departmental Influence on Specimen Rejection

The study demonstrated that the highest rates of specimen rejection were observed in the ICU and emergency department. This is consistent with findings from other studies, which have reported higher pre-analytical error rates in critical care settings (Lippi et al., 2012).

The ICU environment is characterized by critically ill patients, frequent blood sampling, and complex clinical conditions. These factors may increase the likelihood of errors during specimen collection.

Similarly, the emergency department operates under time constraints and high patient turnover, which may affect adherence to standardized procedures. These conditions can contribute to an increased risk of specimen rejection.

The presence of rejection across multiple departments indicates that specimen rejection is not limited to a specific unit but represents a system-wide issue requiring coordinated interventions.

5.6 Impact of Collector Experience and Staff Turnover

One of the most significant findings of this study is the clear relationship between collector experience and specimen rejection. Newly recruited staff were associated with the highest rejection rates, while highly experienced staff demonstrated the lowest rates (Green, 2013).

This finding highlights the critical role of experience and training in ensuring specimen quality. Newly recruited staff may lack the practical skills and familiarity required for proper specimen collection, which increases the likelihood of pre-analytical errors.

In tertiary care hospitals, where staff turnover may be high, maintaining consistent levels of competency can be challenging. The continuous introduction of new staff requires ongoing training and supervision to ensure adherence to standard procedures.

This study emphasizes that staff turnover is not only an administrative issue but also a significant factor affecting laboratory quality and patient care.

5.7 Documentation and Data Quality Issues

An important observation in this study was the presence of a notable proportion of unspecified or unclear rejection reasons. This finding suggests potential gaps in documentation practices within the laboratory.

Accurate documentation is essential for monitoring quality indicators and identifying areas for improvement. Incomplete or unclear records may limit the ability to perform detailed analysis and implement targeted interventions.

Improving documentation practices should therefore be considered a priority in laboratory quality management.

5.8 Implications for Practice

The findings of this study have several practical implications for improving laboratory performance and patient care.

First, there is a clear need for continuous training programs focusing on proper specimen collection techniques. These programs should target both newly recruited and existing staff to ensure consistent competency levels.

Second, standardized protocols should be reinforced across all departments to minimize variability in specimen collection practices.

Third, regular monitoring of specimen rejection rates should be implemented as part of the laboratory quality management system. This will allow for early identification of issues and timely corrective actions.

Finally, improving communication between laboratory staff and clinical departments is essential to ensure proper handling and transport of specimens.

5.9 Comparison with Previous Studies

The findings of this study are consistent with previous research in laboratory medicine. Several studies have reported that hemolysis is the leading cause of specimen rejection, followed by clotting and insufficient sample volume (Lippi et al., 2012; Simundic, 2014).

Additionally, the association between staff experience and specimen quality has been highlighted in previous studies, which emphasize the importance of training and competency assessment.

The consistency of these findings with existing literature supports the validity of the results and confirms that specimen rejection is a global challenge in laboratory practice.

5.10 Summary of Discussion

In summary, the findings of this study demonstrate that specimen rejection is primarily associated with pre-analytical errors, particularly hemolysis. The results also highlight the influence of clinical environment and staff experience on specimen quality.

The study underscores the importance of targeted interventions, including staff training, standardization of procedures, and improved documentation, to reduce specimen rejection and enhance laboratory performance.

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Appendices

Appendix A: Data Collection Sheet

Variable	Description
Department	Clinical department requesting the test
Reason of rejection	Cause of specimen rejection
Nurse ID	Identification number of the collector

Appendix B: Classification of Rejection Causes

Category	Description
Sample quality errors	Hemolyzed, clotted, insufficient volume
Collection errors	Wrong tube, under-filled
Handling errors	Temperature issues, delay, leakage
Identification errors	Labeling errors

Appendix C: Collector Experience Classification

ID First Digit	Experience Level
1	Highly experienced
2	Experienced
3	Moderately experienced
4	Newly recruited staff

المستخلص

تلعب الفحوصات المخبرية دورًا محوريًا في اتخاذ القرارات السريرية، وتعتمد دقة النتائج المخبرية إلى حد كبير على جودة العينات المجمعة. وتُعد الأخطاء التي تحدث خلال المرحلة ما قبل التحليلية من أكثر التحديات شيوعًا التي تواجه المختبرات السريرية على مستوى العالم. ومن بين هذه الأخطاء، يُعتبر رفض العينات مؤشرًا مهمًا على جودة الأداء، نظرًا لما قد يسببه من تأخير في التشخيص، وزيادة عبء العمل على المختبر، والحاجة إلى إعادة سحب العينات من المرضى.

هدفت هذه الدراسة إلى تحليل أسباب رفض العينات في مختبر مستشفى للرعاية التخصصية، بالإضافة إلى تحديد العوامل التشغيلية المرتبطة بالأخطاء في المرحلة ما قبل التحليلية. وقد تم إجراء دراسة مقطعية بأثر رجعي بالاعتماد على سجلات رفض العينات المخبرية خلال الفترة من يوليو إلى ديسمبر 2025. وشملت الدراسة تحليل 1,240 عينة مرفوضة. وتم فحص البيانات لتحديد أنماط الرفض حسب الشهر، والقسم، وسبب الرفض، ومستوى خبرة القائم بسحب العينة.

أظهرت النتائج أن العينات المتحللة دميًا كانت السبب الأكثر شيوعًا للرفض، تليها العينات المتجلطة ونقص حجم العينة. كما لوحظ أن حالات رفض العينات توزعت على عدة أقسام في المستشفى، خاصة في أقسام الطوارئ والعناية المركزة. بالإضافة إلى ذلك، أشارت النتائج إلى أن الموظفين الجدد كانوا أكثر ارتباطًا بمعدلات رفض أعلى مقارنةً بالموظفين ذوي الخبرة.

تُبرز هذه الدراسة أهمية تحسين ممارسات سحب العينات، وتعزيز برامج تدريب الكوادر الصحية، وتطبيق أنظمة متابعة مستمرة لاتجاهات رفض العينات في المختبرات داخل المستشفيات.

الكلمات المفتاحية:

الفحوصات المخبرية، رفض العينات، الأخطاء ما قبل التحليلية، انحلال الدم، مستشفى رعاية تخصصية، مؤشرات الجودة، خبرة الكادر، جودة المختبر.

العنوان:

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2026 – 2025