

Standardizing Sample Error Data Collection Across a Multisite Healthcare Network: A Pan-Apollo Nursing Initiative

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Abstract: Sample errors can compromise diagnostic accuracy, delay treatment, and undermine patient safety. Prior to this initiative, inconsistencies in error definitions and denominator selection across Apollo Hospitals hindered accurate reporting and quality improvement. Most units reported only identification-related errors and calculated rates using the number of investigations rather than the correct Sample Identification Number (SIN). A Pan-Apollo nursing initiative was launched to standardize numerator components, define SIN as the denominator, and implement structured reporting and feedback. This intervention has enhanced error tracking, data validity, and overall patient safety across the network.

Key Words: sample error, SIN number, sample collection, quality improvement, patient safety, healthcare standardization, Apollo Hospitals, laboratory accuracy, identification error.

1. INTRODUCTION

- Accurate and standardized data collection is essential to ensure diagnostic quality and patient safety in clinical laboratories. At Apollo Hospitals, a leading multisite healthcare provider in India, discrepancies were identified in how sample errors were reported across its facilities. These discrepancies included inconsistent definitions of sample error, varied reporting formats, and significant gaps in lab coverage across Biochemistry, Hematology, Histopathology, Cytopathology, Microbiology, Immunology, and the Blood Bank.
- Crucially, most facilities calculated error rates using the **total number of investigations** as the denominator, rather than the correct **Sample Identification Number (SIN)**. This led to skewed and misleading error rates. Furthermore, only **identification errors** were consistently reported, with other critical pre-analytical errors often being omitted, a finding consistent with global literature on pre-analytical error sources (1,2).
- The SIN number is a unique identifier generated for each individual laboratory sample collected from a patient. It represents the actual number of samples drawn, not merely the number of tests ordered. Since multiple investigations can be performed on a single sample, using the total investigation count can distort error rates. The SIN number, by contrast, ensures a one-to-one correlation with the physical act of sample collection, making it the most accurate and consistent denominator for tracking pre-analytical errors.
- These inconsistencies mirrored challenges reported in similar healthcare networks, where denominator and error classification discrepancies hinder meaningful comparisons and improvements (1,3).

- To address these gaps, a Pan-Apollo Nursing Quality Initiative was launched under the leadership of Capt. (Dr.) Usha Banerjee. The initiative aimed to unify definitions, enforce the correct denominator, ensure full departmental participation, and standardize data collection for a network-wide improvement in sample quality and patient safety.

2. LITERATURE REVIEW

Global studies confirm that pre-analytical errors account for the majority of laboratory mistakes and are often underreported due to inconsistent definitions and denominator selection. Using the number of investigations instead of the number of collected samples leads to inaccurate error rates, masking systemic issues. International best practices recommend standardized numerator classification and denominator usage to ensure comparability and reliability.

3. OBJECTIVES:

- Standardize sample error numerator definitions across Apollo Hospitals
- Enforce SIN as the denominator for error rate calculation
- Implement a structured reporting and feedback framework
- Introduce a three-point patient identification system
- Strengthen accountability and staff ownership through transparent reporting.

4. RESEARCH METHOD :

Before the intervention:

- Only identification errors were consistently reported across most units.
- The denominator was incorrectly calculated as the total number of investigations rather than the number of Sample Identification Numbers (SINs), which accurately reflect the number of samples collected.
- There was no uniform process for error collection, reporting, or analysis.
- Inter-unit comparisons and monthly quality reviews were inconsistent and often misleading.

Objectives

- Standardize the definition of sample error numerators across all Apollo Hospitals.
- Enforce the use of the SIN number as the denominator for calculating sample error rates.
- Implement a structured, closed-loop error tracking and feedback system.
- Introduce a three-point verification system to reduce patient identification-related errors.
- Improve staff awareness and ownership through shared accountability.

Pan-Apollo Nursing Leadership Meeting

In November 2024, nursing leaders and sample error custodians from 41 Apollo units convened to align on unified definitions and a common reporting framework. This collaborative session led to the formation of a standardized error taxonomy and data collection protocol, following international recommendations for minimizing pre-analytical variability (1).

Revised Formula

To address previous discrepancies in denominator usage, the following formula was adopted:
Sample Errors per 1000 Investigations = (Number of Sample Errors / Total Samples Collected [SIN No.]) × 100

Standardized Numerator Components

Sample errors now include:

1. Insufficient sample volume
2. Clotted samples (when not required)
3. Missing or incorrect labeling

4. Haemolysed samples due to technique
5. Diluted samples
6. Samples in the wrong vacutainer/container
7. Wrong patient identifiers
8. Mismatched or incorrect samples
9. Missed samples (ordered but not collected)

These categories reflect standard classifications recommended by clinical laboratory best practices (2,3).

Denominator Definition

The denominator is standardized to total Sample Identification Numbers (SINs), accurately representing the number of physical samples collected.

Reporting Process

A structured daily and monthly workflow was instituted:

- Error Occurrence → Staff Reporting → Daily Collection by Custodians (across all labs) → Monthly Analysis → Feedback → Corrective Action Planning → Trend Monitoring

Safety Enhancements

A three-point identification system was mandated:

1. Verbal confirmation from the patient
2. Verification of wristband
3. Matching the label with the order form at the bedside

Closed-method sample collection was also introduced in high-volume areas to reduce contamination risk.

Denominator Definition

The denominator is standardized to the total Sample Identification Numbers (SINs) — ensuring accurate reflection of the actual number of samples collected.

5. FINDINGS

Initial observations from post-standardization implementation show:

- More consistent and reliable data collection across all units
- Increased participation from all laboratory departments
- Reliable cross-unit benchmarking
- Greater nursing and lab staff engagement and accountability
- Identification of systemic issues leading to targeted staff training

Pre-standardization data collection

An internal audit across 41 Apollo units revealed inconsistent sample error data collection across various laboratory departments. The following percentages represent the extent of data collection from each lab area:

- Biochemistry Lab: 86.84%
- Haematology Lab: 76.31%

- Microbiology and Histopathology Labs: 65.78%
- Cytopathology Lab: 42.10%
- Blood Bank: 57.89%
- Immunology Lab: 28.94%
- None of the Above: 5.26%

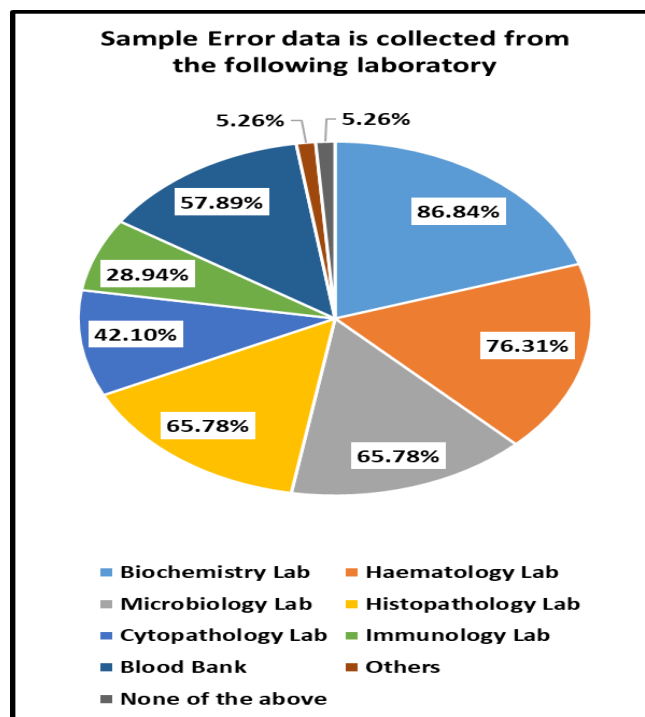
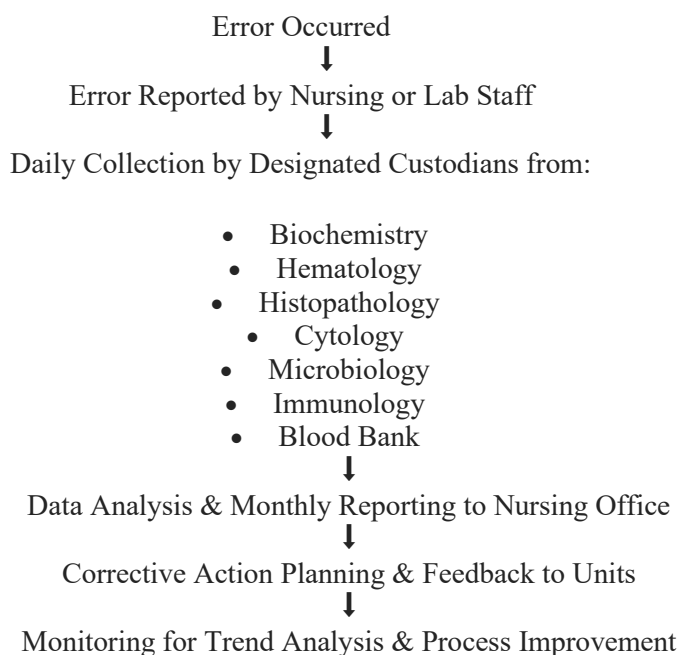


Figure 1 indicates that not all units were collecting data from all laboratory areas; otherwise, the percentages

Standardized sample error reporting process



Safety enhancements

A three-point patient identification system was introduced to minimize ID-related errors:

1. Verbal confirmation from the patient
2. Verification of wristband
3. Matching the label with the order form at the bedside

Additionally, closed-method sample collection was introduced in high-volume areas to minimize contamination and reduce sample handling variability.

Outcomes

Following the Pan-Apollo Nursing Initiative, early indicators reflect substantial improvements in the standardization and accuracy of sample error data collection across the network. Key outcomes observed include:

- Improved consistency in data reporting across units
- Enhanced reliability of sample error metrics due to standardized definitions
- More accurate performance comparisons between units through unified denominator usage
- Greater engagement and accountability among nursing and laboratory teams
- Root cause identification supporting targeted training interventions

A critical achievement was the correction of denominator selection. Prior to standardization, the majority of units incorrectly used the total number of investigations as the denominator instead of the actual number of samples collected (Sample Identification Number or SIN). This miscalculation led to misleading error rates and hindered effective quality improvement.

After the standardization efforts led by the Sample Error Task Force, a notable shift was observed:

Audit Phase	Used SIN Number as Denominator (YES)	Did Not Use SIN Number (NO)
Before Standardization	31.25%	68.75%
After Standardization	70.70%	29.20%

This transformation reflects a 39.45% increase in correct denominator usage across Apollo units, ensuring that sample error rates now more accurately represent the actual number of physical samples collected. This enhancement is foundational to driving reliable error tracking, benchmarking, and continuous quality improvement across the multisite healthcare network.

6. DISCUSSION

This initiative illustrates the importance of consistent definitions and proper denominator selection in quality assurance reporting. The literature confirms that denominator inconsistency—such as using the total number of investigations instead of individual samples—leads to misleading error rates and underestimates systemic issues (1,3).

By standardizing both the numerator and denominator, Apollo Hospitals has implemented a sustainable model for benchmarking and continuous quality improvement that aligns with global pre-analytical error control frameworks (1,2).

7. CONCLUSION

The standardization of sample error data collection across Apollo Hospitals has strengthened diagnostic reliability, improved staff accountability, and promoted a culture of continuous quality improvement. This initiative provides a



replicable model for other large healthcare systems aiming to enhance laboratory safety and harmonize clinical data processes.

8. LIMITATIONS

- Early-stage data; long-term trend validation is ongoing
- Implementation variations may persist across smaller units
- Dependence on accurate reporting by staff

9. RECOMMENDATIONS

- Sustain continuous monitoring through regular audits
- Expand closed-method sample collection to all high-volume units
- Integrate automated error detection technologies
- Extend initiative to allied healthcare processes (e.g. Laboratory services, sample handling)

ACKNOWLEDGMENTS

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