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Impact Of Laboratory Personnel Training On Pre-Analytical Errors And Laboratory Reporting

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ABSTRACT

Background: The most frequent cause of laboratory diagnostic errors is pre-analytical errors (PAEs). The majority of these mistakes can be avoided and are caused by human factors. Therefore, to evaluate and contrast the types and frequency of pre-analytical errors prior to and following structured training for laboratory staff at GMC Nalgonda.

Methods: Two phases of a retrospective comparative study were carried out between October 2023 and September 2024: pre-training (October 2023–March 2024) and post-training (April 2024–October 2024). Analysis was done on 282,010 patient samples from both inpatient and outpatient units. Structured sessions and reinforcement exercises centered on phlebotomy, labelling, transport, and documentation were among the training interventions. Chi-square and t-tests were used to compare rejected samples and their reasons; a p-value of less than 0.05 was deemed significant. Results: Rejection rates significantly decreased from 22.15% to 8.57% post-training (p<0.001). Major improvements were noted in inadequate samples (↓52.4%), clotted samples (↓54.2%), and inappropriate vacutainers (↓49.1%). Site-wise analysis showed significant error reductions in GGH-IP and MCH-IP samples. Conclusion: Systematic training of laboratory staff significantly reduces pre-analytical errors, improving the quality of laboratory services and patient safety. Regular audits and refresher sessions are recommended for sustained improvement.

1. INTRODUCTION

The clinical laboratory is essential for diagnosing and owup after therapy. It has to produce fast and accurate results. The demand for confidence and precision in lab testing has increased in the health care sector. Nevertheless, errors may occur in any phase (preanalytical, analytical, and post analytical) leading to laboratory errors[1]. These mistakes can result in a misdiagnosis or a wrongly prescribed treatment, justifying any further investigations and contributing to dissatisfaction with healthcare services. Recall of specimens due to rejections may also contribute to turn-around-time (TAT), impede

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timely diagnosis or patient treatment and negatively impact patient care[2].

Among the laboratory mistakes, approximately 60%-70% of errors are due to preanalytical mistakes[3] includes mislabelled, hemolysed, clotted, lipemic and unsuitable vacutainer & transportation defects. The majority of these mistakes are due to human error in results interpretation may have an important role in the reliability of tests and could impact on patient care and costs[3]. Gradually, the awareness on preanalytical errors (PE) has been advancing, and most of these human PE maybe prevented by providing hands-on training, the staff attitude and knowledge have always managed to decrease these errors[3]. Talented phlebotomists still produce good flow, low error, even under high pressure. Health institutions which are committed to organized education and staff training have better diagnostic accuracy and patient satisfaction [4]. Therefore, this research aims to examine the extent to staff training influences the reduction of diagnostic errors in clinical laboratories, using data from practical case studies and performance evaluations in real-world settings and improving reporting accuracy.

MATERIALS AND METHODS:

The present retrospective comparative study conducted at Department of Biochemistry, from 1st October 2023 to 31st September 2024. A total study was divided to two session like before training of professionals (from 1st October 2023 to 31st march 2024) and after training of professionals (from 16th April 2024 to 15th October 2024) were also closely monitored by a lab doctor rectified their doubts, in between 15 days the laboratory personnel had undergone structured and reinforcement training. A total of 282010 sample were collected from who were attending as out patient unit and in-patient units of Government Medical College, Nalgonda. Samples were collected and analysed for the requested tests and in that some sample were rejected due to the preanalytical errors like inadequate samples, clotted samples, hemolyzed samples, inappropriate vacutainer, wrong sample for the requested test, double billing, and transportation defects. The type of preanalytical errors before and after providing training were analyzed. Data was compiled, tabulated and analysed using MS Excel. Continuous variables were expressed as means and standard deviations (SD). Categorical variables were tested using the Chi-square test, and continuous variables were evaluated using the t-test. A p-value < 0.05 was considered statistically significant.

RESULTS:

Table No.01: showing the Total no of samples and Total no of rejected samples before and after training.

Total no. of Samples		Total no. of Rejected samples	
Before training	After training	Before training	After training
122346	159664	27107 (22.15%)	13681 (8.57%)

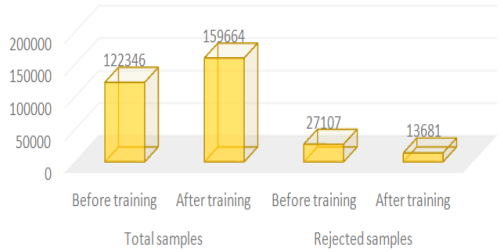

Fig. No.01: showing the Total no of samples and Total no of rejected samples before and after training.

Table No.02: showing the Mean, SD of Total no of samples and Total no of rejected samples before and after training. And its comparison.

		Mean	SD	P-value
Total samples	Before training	20391.00	3393.41	0.05
	After training	26610.67	5906.23	
Rejected samples	Before training	4517.83	305.99	0.00
	After training	2280.17	523.63	

*statistically significant ($p<0.05$).

Table No.03: showing different **Reason for rejection** sample before and after training.

Reason for rejection	Before Training	After Training	% Reduction
Inadequate Samples	8316	3959	52.4%
Clotted Samples	5250	2405	54.2%
Inappropriate Vacutainer	3809	1938	49.1%
Wrong Sample for Test	3110	1658	46.7%
Hemolysed	2329	1377	40.9%
Mislabelled	1852	982	46.9%
Transportation Defect	1405	809	42.4%
Double Billing	945	484	48.8%

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Table No.04: showing the Mean, SD and comparison of GGH, MCH OP and IP total number of samples and rejected sample before and after training.

			MEAN	SD	p-value
GGH-IP	Total No. Of samples	Before	4863.17	1015.76	0.03*
		After	6606.33	1387.44	
	Rejected samples	Before	752.33	149.74	0.00*
		After	157.33	116.00	
GGH-OP	Total No. Of samples	Before	3854	1473.65	0.00*
		After	7710	1831.17	
	Rejected samples	Before	696.83	128.81	0.00*
		After	332.17	153.52	
MCH-IP	Total No. Of samples	Before	6225	1604.84	0.46
		After	7436.67	3562.07	
	Rejected samples	Before	1739.67	509.46	0.00*
		After	461.67	329.43	
MCH-OP	Total No. Of samples	Before	5448.83	3264.82	0.70
		After	4857.67	1639.68	
	Rejected samples	Before	1329	251.52	1.00
		After	1329	251.52	

*statistically significant ($p<0.05$).

DISCUSSION:

The primary reason for specimen rejection in clinical laboratories is pre-analytical errors. Rejecting a specimen causes discomfort and inconvenience during subsequent collection, which delays the release of test results. Therefore, for clinical laboratories, monitoring the acceptability of specimens is a crucial quality assurance measure [5].The current study proposes strong proof that pre-analytical errors (PAEs), which continue to be an important contributory factor of diagnostic errors in clinical laboratories, can be considerably decreased by laboratory staff through organized training and reinforcement sessions. The effectiveness of focused educational interventions in improving laboratory quality was demonstrated by the significant decrease in the rejection rate from 22.15% before training to 8.57% after training, out of a total of 282,010 samples examined and Additionally, suggesting appropriate training for phlebotomists was crucial in the negligible decrease of pre-analytical errors[3, 6- 9].

In our study, the most common reasons for rejection prior to training were inadequate samples (8316), clotted samples (5250), and use of inappropriate vacutainers (3809). These reasons all significantly decreased after training, indicating improved procedural compliance and awareness. Pre-analytical errors, which include problems like hemolysis, clotted samples, incorrect container usage, and mislabeling, are often recognized to account for 60–70% of total laboratory errors and are primarily attributed to human error during the specimen collection and handling[3].

In our study the decline in hemolysis-related rejections from 2329 to 1377. Furthermore, the decrease in incorrect sample-test pairing and transportation flaws demonstrates how successful it is to enforce SOPs and keep an eye on compliance. These features are consistent with the results of Salinas et al., who highlighted that internal audits and continual staff training greatly reduce pre-analytical variability and speed up turnaround time [3, 6- 11].

Significant improvement was also observed in both outpatient and inpatient departments, especially in GGH-IP and MCH-IP, according to statistical analysis of site-wise data (GGH-IP, GGH-OP, MCH-IP, and MCH-OP). This highlights the consistency of training outcomes across various healthcare settings. Some departments (like MCH-OP) did not demonstrate a post-training improvement in rejection rates. This could have been because of staffing or external logistical issues.

In summary, our results affirm the hypothesis that systematic training and ongoing monitoring can dramatically lower pre-analytical errors and enhance overall laboratory performance. The results underscore the need to institutionalize continuous education programs, regular audits, and process optimization as part of quality assurance frameworks in clinical laboratories.

CONCLUSION:

All things considered, our findings support the idea that regular training and observation can significantly reduce pre-analytical errors and improve overall laboratory performance. The findings highlight the necessity of integrating process optimization, frequent audits, and ongoing education programs into clinical laboratory quality assurance frameworks.

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