Quality Improvement Project on Impact of a Modified Blood Collection Protocol on Hemolysis Rates and Sample Rejection at Apollo Multispeciality Hospitals, Kolkata

Abstract

Introduction: Hemolysis, caused by rupture of red blood cell membranes and subsequent release of hemoglobin into serum or plasma, is a major pre-analytical error in blood sample collection and a leading cause of sample rejection. Hemolysis was one of the most common pre-analytical errors in laboratory testing.

Objectives: To minimize sample rejection associated with hemolysis and clotting

Methods:

This project utilized DMAIC process to implement modified protocol for blood collection to reduce hemolysis rate and sample rejection. Project was conducted at Apollo Multispeciality Hospital from October 2024 to September 2025 into two phase, pre intervention and post intervention phase and data was collected through haemolysis survey report to identify the hemolysis rate and RCA was done to identify the cause of hemolysis. Observation checklist had been done to assess the practice among staff nurses on sample collection process. All blood samples collected by the nurses were taken for the study except paediatric, neonates, disease condition like coagulopathy, pancytopenia, anasarca and patient on anticoagulant. Collected data were analysed through Pareto chart against standards using Root Cause Analysis (RCA). Then modified protocol had been developed, implemented and continuing it in post intervention phase in view to reduce hemolysis rate and the effect of modified protocol. Audit and cross audit had been done to sustain the process and reduce the hemolysis rate.

Result:

This project found noticeable reduction in the frequency of hemolysis sample. There was decreasing trends of hemolysis rates from 203 to 56 and practice score enhanced in post implementation phase.

Key words: Hemolysis, modified protocol, sample collection, sample rejection,

Introduction

Hemolysis was one of the most common pre-analytical errors in laboratory testing. The study helped to identify falsely elevated or decreased lab values, improve reliability of laboratory reports resulting in reduced diagnostic errors and enhance overall patient care. Haemolysis had a major impact on infusion safety as the need for a repeat test increases the risk of injury, phlebitis, too many pricks and delayed test results leading to increase in hospital stay and dissatisfaction for patient and family that the hemolysis rate was in increasing trend. So, it was necessary to improve diagnostic accuracy, patient safety, laboratory quality, and understanding of disease processes.

Objectives

To minimize sample rejection associated with hemolysis and clotting

Literature Review

During hemolysis, red blood cell (RBC) membranes rupture, resulting in the release of hemoglobin (Hb) into the serum. Inappropriate blood sample collection is one of the major causes of hemolysis and the primary cause of sample rejection. When blood samples are hemolysed they can produce unreliable laboratory results. Problems in specimen collection are the largest causes of hemolysis and include alcohol pad contamination of blood specimens, vein trauma, excessive negative pressure during syringe draws, and vigorous shaking of specimens after collection. The American Society of Clinical Pathology has defined a hemolysis rate of ≤2% as the benchmark for the best sample collection practice.

Lee H, Kim C, Shin H et al[1] conducted a prospective study on Hemolysis Control in the Emergency Department by Interventional Blood Sampling among 260 patients. They found that hemolysis rate of the new blood collection method was 1.9% (5/260), which was significantly lower than that of the conventional method (7.3%; 19/260) (p = 0.001). The new blood collection method can reduce the hemolysis rate as compared to the conventional blood collection method.

Koning D L, Orton D, Long I S et al[2] conducted a study on distribution of videos demonstrating best practices in preventing hemolysis is associated with reduced hemolysis among nurse-collected specimens in hospital. They found that In +/- 3 months of data flanking video distribution (n = 137 241 collections), where overall impact was strongest, H-index trajectory (change in units per week) decreased immediately following video distribution (-5.7% / week, $p < 0.01$). This was accompanied by a 22% drop in overall H-index from the week before to the week after video distribution (y-intercept change, or gap).

George M N[5] had done a prospective interventional study on Reducing Blood Sample Hemolysis at a Tertiary Hospital Emergency Department. They observed that They were able to attain a reduction in sample hemolysis from 19.8%to 4.9% through the change in operator behaviour which was brought by the educational interventions. Finally, with the introduction of an educational program they were succeeded in bringing reduction in sample hemolysis.

Methodology

This project utilized DMAIC process to implement modified protocol for blood collection to reduce hemolysis rate and sample rejection. Project was conducted at Apollo Multispeciality Hospital from October 2024 to September 2025 into two phase, pre intervention and post intervention phase and data was collected through haemolysis survey report to identify the hemolysis rate and RCA was done to identify the cause of hemolysis. Observation checklist had been done to assess the practice among staff nurses on sample collection process. All blood samples collected by the nurses were taken for the study except paediatric, neonates, disease condition like coagulopathy, pancytopenia, anasarca and patient on anticoagulant. Collected data were analysed through Pareto chart against standards using Root Cause Analysis (RCA). Then modified protocol had been developed, implemented and continuing it in post intervention phase in view to reduce hemolysis rate and the effect of modified protocol. Audit and cross audit had been done to sustain the process and reduce the hemolysis rate.

Modified Protocol

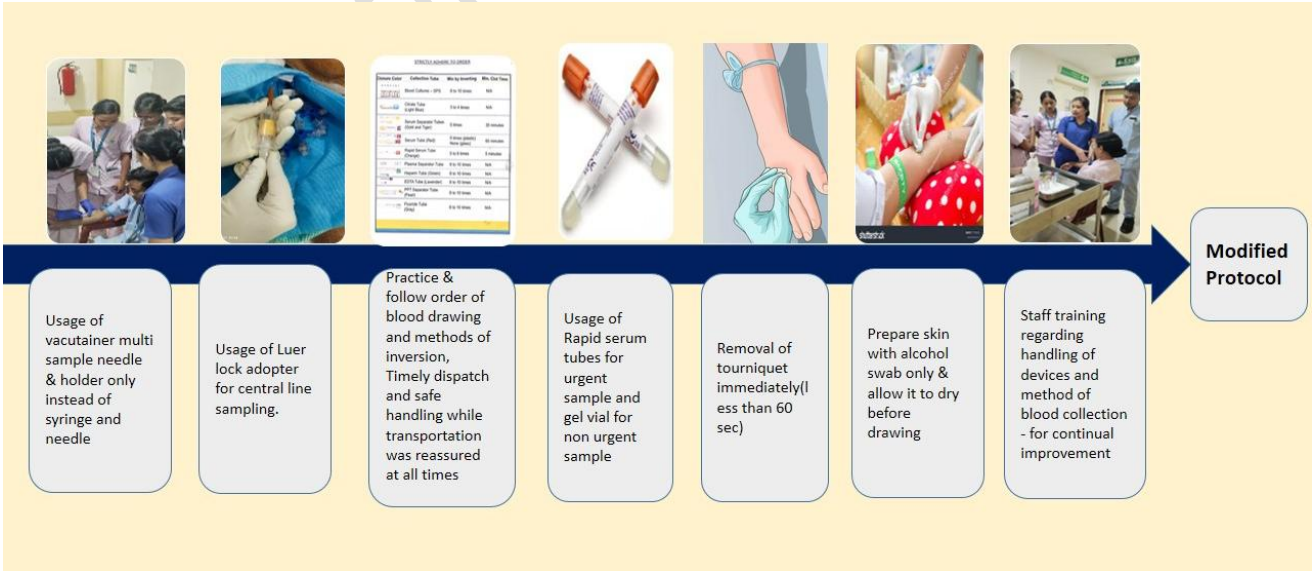

Figure 1: This figure illustrates a modified blood collection protocol with several revised steps in the blood collection process.

Result

This project found noticeable reduction in the frequency of hemolysis sample. From the line graph we can see that decreasing trends of hemolysis rates in post implementation phase and bar graph showed practice score enhanced in post implementation phase.

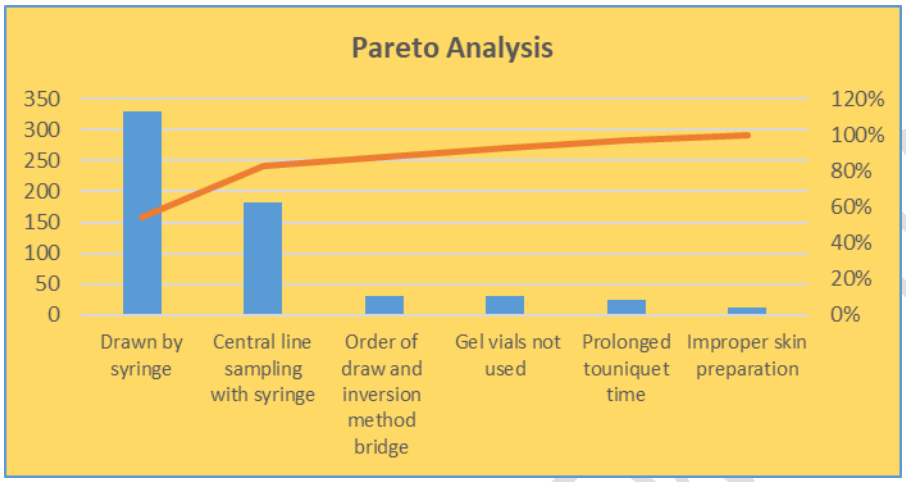

Figure2: In this pareto graph cumulative percentage curve showed that the first **two causes** comprising of 20% of the problems are responsible for nearly **80% of the causal impact**, indicating that these are the **vital few** factors. The remaining causes represent the **trivial many**, each contributing minimally to the overall issue.

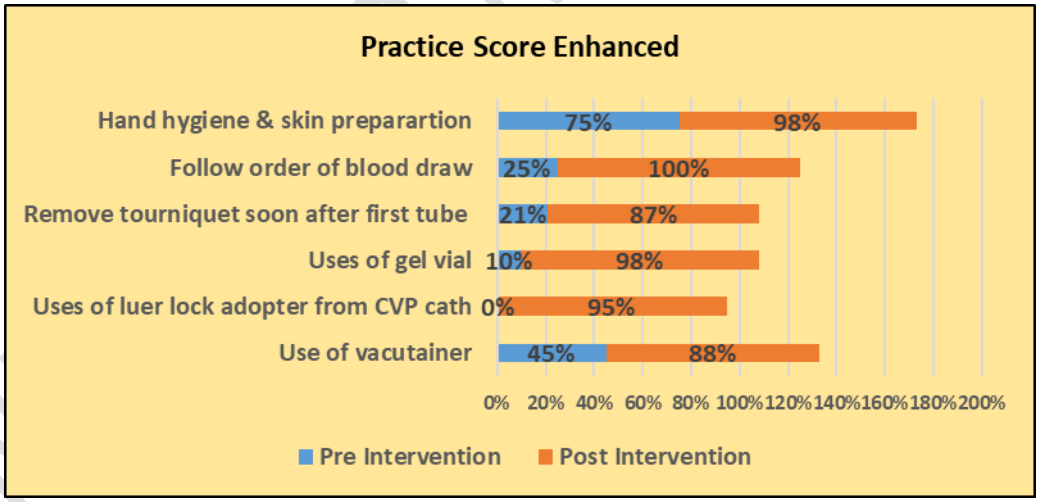

Figure3: This bar diagram showed that practice score for uses of luer lock adopter, vacutainer and gel vial, improved from 0 % to 95%, 45 % to 88% and 10% to 98%.

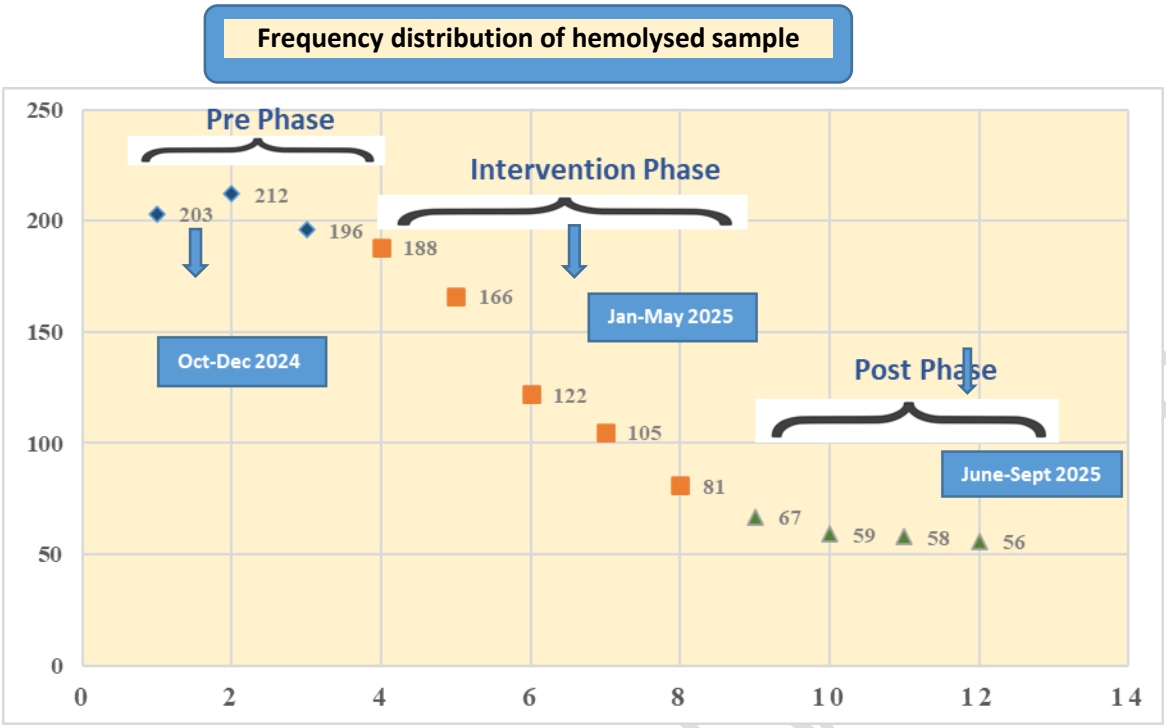

Figure 4: This line graph showed that hemolysis number was more in pre intervention phase (October24-December 24) which gradually decreased in post intervention phase (June 25- September 25) from 203 to 56.

Discussion: -

Allawy A E M, Ibrahim H M[3] conducted a cross sectional descriptive exploratory study on Nurses' Performance Regarding Prevention of Hemolysis in Venous Blood Sampling: Suggested Nursing Guidelines among 20 nurses. They found that regarding practice areas, 92.4% of studied nurses had unsatisfactory practices regarding the prevention of hemolysis, which was similar to our study that pre intervention practice score was unsatisfactory which become satisfactory in post intervention phase.

Phelan P M, Reineks Z E, Shold D J[4] conducted a study on Preanalytic Factors Associated With Hemolysis in Emergency Department Blood Samples. They observed that overall hemolysis was 10.0% (5439 of 54 531). For blood drawn with a syringe compared with vacuum, hemolysis was 13.0% (92 of 705) and 11.0% (1820 of 16 590), respectively. For IV-drawn blood with tourniquet time less than 60 seconds, hemolysis was 10.3% (1362 of 13 162) versus 13.9% for more than 60 seconds (532 of 3832). The findings of this study was similar to our study that frequency rate of hemolysed sample was on reducing trends in post intervention phase by implanting modified protocol for sample collection.

Outcome: The study successfully identified the overall incidence of hemolysed blood samples. The new modified protocol in this study reduced the hemolysis rate from 203 to 56 compared to the conventional blood collection method.

Limitation:

The study was conducted at a single institution and non-randomized sampling technique, which may limit the generalizability of the findings to other healthcare settings with different patient populations, staffing patterns, or blood collection practices.

Future Scope:

- Multicentre validation studies: Future research should evaluate the modified blood collection protocol across multiple healthcare institutions to improve generalizability and assess its effectiveness in diverse clinical settings
- Randomized or controlled study designs
- Development of standardized guidelines: Findings from future studies could contribute to the development of institution-wide or national guidelines.

Conclusion:

Hemolysis of samples is largely preventable through adherence to standard operating procedures, proper nurses training on sample collection method, correct sample handling, and timely processing. Emphasis on continuous staff education, regular audit of hemolysis rates, and implementation of corrective and preventive actions (CAPA) through modified protocol can significantly reduce hemolysis and improve overall laboratory performance and patient care.

Reference

1. Lee H, Kim C, Shin H et al. Hemolysis Control in the Emergency Department by Interventional Blood Sampling. Journal of Personalized Medicine. 2023 April; 13(4)
2. Koning D L, Orton D, Long I S et al. Distribution of videos demonstrating best practices in preventing hemolysis is associated with reduced hemolysis among nurse-collected specimens in hospitals. Clinical Biochemistry. 2023 September; vol(119).
3. Allawy A E M. Ibrahim H M. Nurses' Performance Regarding Prevention of Hemolysis in Venous Blood Sampling: Suggested Nursing Guidelines. Egyptian Journal of Health Care. 2023 September;14(3)
4. Phelan P M, Reineks Z E, Shold D J . Preanalytic Factors Associated With Hemolysis in Emergency Department Blood Samples. Arch Pathol Lab Med. 2018 February;Vol 142:229-235
5. George M N. Reducing Blood Sample Hemolysis at a Tertiary Hospital Emergency Department. Texila International Journal. 2018 November; Vol 5(2)