Root Cause Analysis of Insufficient Centrifugation and Sample Aliquoting of Blood Samples in Clinical Chemistry Laboratory

Dr. Khushbu Soni[1], Dr. Riddhi Patel[2*]

[1]Assistant Professor, Dept. of Biochemistry, Amaltas Institute of Medical Sciences, Dewas Madhya Pradesh, India
[2]Assistant Professor, Dept. Of Biochemistry, Dr.Mk Shah Medical College and Research Institute, Ahmedabad, India

Original Research Article

*Corresponding author
Dr. Riddhi Patel

Abstract: The study aims to find out root cause for insufficient centrifugation and sample aliquoting of blood samples in clinical chemistry laboratory. Blood samples centrifuged in the laboratory were aliquoted by technicians in to 1.5 ml eppindorf cups for placement in to automated chemistry analyser. The aliquotes were allowed to settle for 1 hour and observed for presence of red rim of settled RBC at the bottom of the cups, indicating insufficient centrifugation and sample aliquoting. Frequency of such samples were analysed for time of day, type of sample tube, amount of residual serum/plasma after aliquoting, origin of sample from hospital departments. Total 13491 sample tubes analysed in 20 days at Biochemistry laboratory of New civil hospital Surat. There were 248 samples showing red rim of RBC at the bottom of the cups. Out of 248, samples received at night constituted 78%. Serum sample have 3 times chances of having insufficient centrifugation and sample aliquoting as compared to fluoride plasma. 86% of sample had residual serum/plasma of <200 ul. Neonate sample have 7 times chances of having insufficient centrifugation and sample aliquoting as compared to adult samples. 97% of samples having insufficient centrifugation and sample aliquoting were received from wards while only 3% were received from OPD. Under filling of collection tubes, neonatal samples, samples collected in plain vacuum tubes, samples collected by phlebotomist on duty at night are root causes for insufficient centrifugation and sample aliquoting.
Keywords: RBC- red blood cells

INTRODUCTION

Remarkable advances in instrument technology, automation and computer science have greatly simplified many aspects of previously tedious tasks in laboratory diagnostics, creating a greater volume of routine work, and significantly improving the quality of results of laboratory testing. Following the development and successful implementation of high-quality analytical standards, analytical errors are no longer the main factor influencing the reliability and clinical utilization of laboratory diagnostics. Therefore, additional sources of variation in the entire laboratory testing process should become the focus for further and necessary quality improvements. Errors occurring within the extra-analytical phases are still the prevailing source of concern. Accordingly, lack of standardized procedures for sample collection, including patient preparation, specimen acquisition, handling and storage, account for up to 93% of the errors currently encountered within the entire diagnostic process. The profound awareness that complete elimination of laboratory testing errors is unrealistic, especially those relating to extra-analytical phases that are harder to control, highlights the importance of good laboratory practice and compliance with the new accreditation standards, which encompass the adoption of suitable strategies for error prevention, tracking and reduction, including process redesign, the use of extra-analytical specifications and improved communication among caregivers [1]. The present study aims to find out one such root cause of error of insufficient centrifugation and sample aliquoting of blood samples in clinical chemistry laboratory.

The pre-analytical phase comprises all the processes occurring before the sample is processed in the analyser. In this phase one may observe the highest frequency of errors, the highest risk to professionals' health and the highest rates of human error. Studies indicate that approximately 40% to 70% of errors occur in the pre-analytical phase [2].

MATERIALS AND METHODS

The new Civil Hospital Surat is a 1150 bed tertiary care academic medical centre. The clinical laboratories include Clinical Biochemistry, Clinical

pathology, and Histopathology laboratory and Microbiology laboratory. In Clinical Biochemistry, the study was performed on sample received over 20 days.

Blood samples centrifuged in the laboratory were aliquoted by technicians in to 1.5 ml eppindorf cups for placement in to automated chemistry analyser.

The aliquotes were allowed to settle for 1 hour and observed for presence of red rim of settled RBC at the bottom of the cups, indicating insufficient centrifugation and sample aliquoting. Frequency of such samples were analysed for time of day, type of sample tube, amount of residual serum/plasma after aliquoting, origin of sample from hospital departments.

Table-I: distribution of total samples examined

| Total Days	20			TOTAL
Total serum (plain) samples	7749	Total plasma (fluoride) samples	5742	13491
neonate	436	neonate	25	461
adult	7313	adult	5717	13030

RESULTS AND DISCUSSION

Total 13491 samples analysed in 20 days at Biochemistry laboratory of New civil hospital Surat. 248 samples showed red rim of RBC at the bottom of the cups. Out of 248, samples received at night constituted 78%. Serum sample have 3 times chances of having insufficient centrifugation and sample aliquoting

than fluoride plasma. 86% of sample had residual serum/plasma of <200 ul. Neonate sample have 7 times chances of having insufficient centrifugation and sample aliquoting than adult samples. 97% of such samples were received from wards while only 3% were received from OPD.

Table-II: distribution of samples according to various parameters

Total insufficient samples	248
Evening	194
Morning	26
Afternoon	28
Total insufficient samples	248
Serum	199
Fluoride	49
Total insufficient samples	248
Neonate	50
Adult	198
Total insufficient samples	248
Samples having serum/plasma volume <=200ul	214
Samples having serum/plasma volume >=200ul	34
Total insufficient samples	248
Samples received from OPD	8
samples received from ward	240

% contribution to total samples with rim of RBC at bottom of secondary tubes according to time of sample collection

% contribution to total samples with rim of RBC at bottom of secondary tubes acording to type of sample

Residual volume in primary tubes as a cause of rim of RBC at bottom
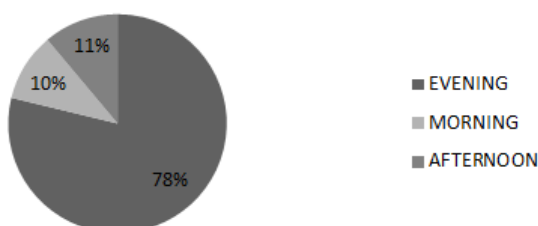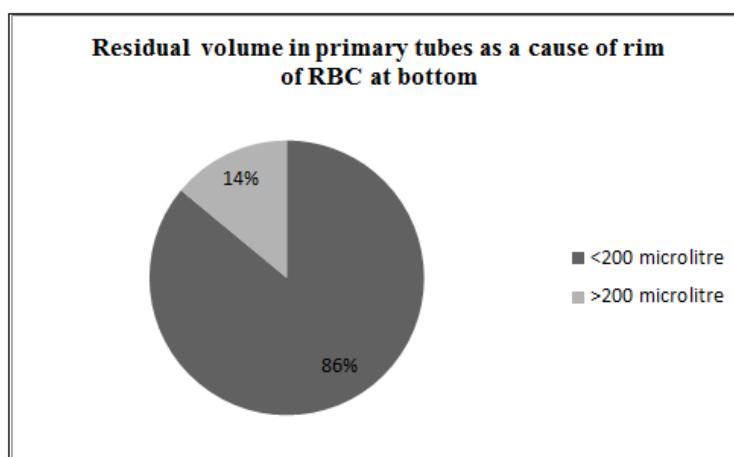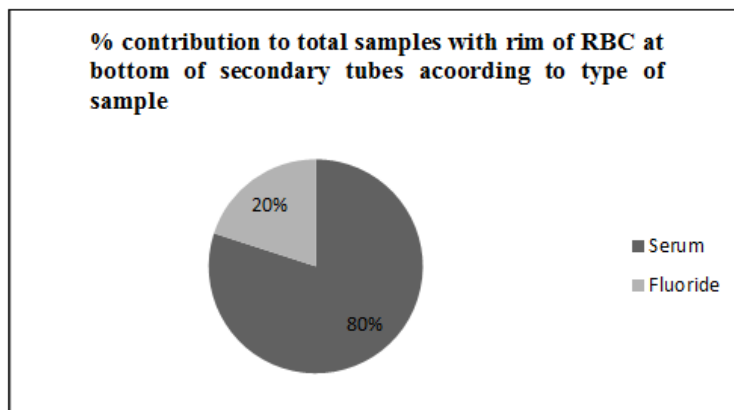
From present study, it is evident that major reason for insufficient centrifugation is when samples centrifuged for less duration and with less rotation per minutes than required. This may be due to lack of standard operative procedure or procedure not followed. Further root cause analysis of faulty procedure leads to excess workload, behavioural problem or less staff at night. The major cause of inappropriate aliquoting is low sample volume, especially paediatric samples.

CONCLUSION

Insufficient centrifugation and sample aliquoting of blood samples in clinical chemistry laboratory is one of major causes of pre analytical errors that should be actively corrected and prevented. Under filling of collection tubes, neonatal samples, samples collected in plain vacuum tubes, samples collected by phlebotomist on duty at night are root causes for insufficient centrifugation and sample aliquoting. Use of proper standard operative procedure and regular training of technicians can improve results. For paediatric sample collections, special techniques should be used.

REFERENCES

1. Lippi, G., Guidi, G. C., Mattiuzzi, C., & Plebani, M. (2006). Preanalytical variability: the dark side of the moon in laboratory testing. *Clinical Chemistry and Laboratory Medicine (CCLM)*, *44*(4), 358-365.
2. Codagnone, F. T., Alencar, S. M. F., Shcolnik, W., Chaves, S. R. D. S., Silva, L. A., Henriques, V. H. O., & Spitz, L. C. (2014). The use of indicators in the pre-analytical phase as a laboratory management tool. *Jornal Brasileiro de Patologia e Medicina Laboratorial*, *50*(2), 100-104.