Review Article

Justifications behind the Rejection of Laboratory Specimens that are Hematological and the Effect on Patient Safety

Richa bandhari [1], Ram charan singh [2]

1 Nepal Medical College and Teaching Hospital (NMC), Nepal: richabandhari@gmail.com
2 Nepal Medical College and Teaching Hospital (NMC), Nepal: ramcharansingh@outlook.com
* Correspondence: richabandhari@gmail.com

Abstract: Diagnostic laboratories provide crucial information to medical practitioners for the diagnosis, treatment, and management of illnesses. The primary objective of phlebotomists should be patient identification. Inappropriate sample preparation and rapid vial inversion can cause partial or complete clotting in blood collection tubes, which might affect test results. The type of anticoagulants or additives is also important for accurate diagnosis. Sequence errors in the draws could lead to tainted samples that are unfit for processing. Aside from pathogenic hemolysis, false hemolysis resulting from inappropriate specimen handling or over-sampling can also impact absorbance-dependent assays. High TG samples impede the measurement of absolute analytic concentration, making them unsuitable for accurate estimation. False test results have long-term effects on patient safety and raise the hospital's financial burden by resulting in issues, delayed therapy, false positives, and unnecessary repeat testing. Clotted samples are the most frequent pre-analytical error, occurring 43.8% of the time.

Keywords: laboratory specimens, hematological effects, patient safety

1. INTRODUCTION

In order to provide modern healthcare, laboratory diagnostic services must be offered. 1. Good test results are essential for the best possible care for patients. On the other hand, clinical laboratory errors might impair clinical decision-making [1]. Accurate laboratory findings are essential for both diagnosing patients and tracking their progress during therapy if they are provided on time. Up to 60–70% of clinical choices are influenced by clinical laboratory data [2]. It is impossible to overstate the significance of appropriate and accurate patient specimens for accurate and dependable laboratory results. Therefore, it is crucial that all specimens delivered to the lab be carefully evaluated and that any faulty specimens be rejected in order to reduce the pre-analytical mistakes [3]. Many problems might arise from inaccurate results, such as the necessity to repeat the assay, unneeded medicine, delayed or inaccurate diagnosis, complications, patient mishandling, and dissatisfied patients. These results lead to increased expenses and suboptimal patient outcomes because they require staff effort and time loss [4]. There may be a significant influence on patient treatment in another 5-25% of cases, and in 13-25% of cases, there may be a delay in care or greater healthcare costs [5]. The pre-analytical phase is the period of time from restriction to sample collection and analysis. This stage is broken down into different parts that begin with the physician's request for a diagnosis from a medical laboratory. These processes include patient preparation, specimen handling, transportation, processing, and storage, all the way up to the specimen's analysis. Up to two thirds of errors have been shown to occur during the pre-analytical stage of sample

processing [6]. System defects and insufficient employee oversight during the sampling and processing phase are the main causes of sample mistakes. Recent studies have demonstrated that the pre- and post-analytic phases of the diagnostic testing loop are mostly overseen by doctors who may not have adequate knowledge of the rapidly evolving field of clinical pathology, which is where errors and patient harm occur most frequently. These errors include, but are not limited to, inaccurate test requests, unsuccessful or delayed results interpretation, and inappropriate application of test results to patient therapy. Too many unsuitable specimens are produced as a result. Hemolysis samples account for 40–70% of specimen non-conformity in clinical laboratories [7], with insufficient or incorrect sample amount (10–20%), wrong container (5–15%), and excessive clotting (5–10%) following closely behind. Less often occurring causes of poor sample quality include repeated freezing-thawing cycles, improper storage conditions, cross-infection of blood tubes, and contaminated infusion fluid [8]. In settings similar to the paediatric ward, where parents or neonatal personnel often remove identifying bands because they believe the wristbands are uncomfortable to the children, it is common for patients to be mistakenly misdiagnosed prior to sample collection [9]. The ordered test(s) may not match the provided information, they may be erroneous, or the tests may have been ordered inappropriately. When collecting samples in the incorrect vials in a laboratory setting, it may lead to sample rejection and the need for recollection [10]. It is not suitable to use lysed, clotted, spilt, icteric, or lipid-enriched samples for quality testing. Lab tests produce incorrect results since even little clots can interfere with the results. This is important for coagulation and haematological testing because if platelets or other corpuscular components become lodged in the clot and the clotting factors are depleted during the coagulation process, blood cell counts will be off. Hemolysis is a major danger to patient safety because it ruins several assays [11]. In vitro hemolysis is primarily caused by painful blood draws, improper sample collection using instruments like catheters or tiny needles, improper sample management (stirring), improper storage states (freezing samples), improper long-distance transportation under unsuitable conditions, and sample respinning following centrifugation. The release of cell components into the samples (e.g., potassium, lactate dehydrogenase), chemical interference (e.g., adenylate cyclase with C Kinase evaluation), and substances that can impede primary and secondary hemostasis are the most frequent sources of interference. The dilution of certain analytes is another factor [12]. Since blood and sodium citrate are combined in evacuated collecting tubes at a predetermined ratio, blood tubes of the wrong volume have an impact on clotting assays. Hemostasis testing will need calcium restoration since the ionised calcium (Ca^{2+}) in venous blood is meant to be sequestered at the preset final sodium citrate concentration in the tube. It is possible that the sample will be incorrectly transported, labelled upon collection, devoid of the time and date, and inappropriately processed before analysis [13]. Samples that satisfy one or more of the rejection criteria will not be considered appropriate for the examinations that the treating physician has requested, and they will be discarded and sent for new sample collection. Rejecting a sample hinders sample analysis, encourages further sample requests, increases time-to-treatment (TTT), postpones patient diagnosis and therapy, and negatively affects patient outcomes [13, 14]. In order to reduce the incidence of errors in routine practise, standardisation of all pre-analytical procedures, including sample collection, transport, handling, and storage, should be prioritised. Two strategies to attain standardisation are following rules, automating processes, and providing ongoing training to medical personnel involved in the blood collection process [15]. There haven't been many initiatives in this field. As a result, these evaluations have enriched the body of knowledge regarding errors in clinical laboratories by identifying the causes of sample rejection and estimating the frequency of pre-analytical errors. Pre-analytical personnel need to

understand the correct procedures, the importance of adhering to them, and the faults that need to be avoided.

2. LITERATURE REVIEW

Medical personnel can obtain vital information from diagnostic laboratories to aid in disease diagnosis, treatment, and management. Analysing the test request and sample to see if they are appropriate for processing is a critical stage in the diagnostic test. Laboratory results are expected to impact 60–70% of the most important decisions pertaining to a patient's health [7]. As a result, the laboratories must guarantee the timeliness and accuracy of each and every result. Diagnostic errors, among many other types of errors in the healthcare sector, are the most common ones that lead to incorrect test interpretation, inappropriate treatment approaches, and a delay in acting upon aberrant results [10]. Irreversible crises are caused by modest errors in 5 to 20 percent of instances [14]. The pre-analytical phase of the testing process is the most error-prone since it is challenging to establish standards there because sampling, sample preparation, and transportation are not directly under laboratory control. The majority of the errors reported in the literature were sample hemolysis, improper and insufficient sampling, incorrect identification, contamination, and clotted specimens. The phlebotomist's top goal should be identifying the patient. According to published research, misidentification errors—which can involve submitting an incorrect test request, incomplete requisition, or the right test on the wrong patient—are the primary source of incorrect diagnoses [13]. Inappropriate sampling practises and quick vial inversion can occasionally result in partial or total clotting within blood collection tubes. This can have an impact on test results, particularly in EDTA and sodium citrate tubes where coagulation depletes clotting factors and lowers platelet count [12]. Furthermore, the kind of anticoagulants or additives used is crucial for correctly diagnosing the patient's condition. For example, the EDTA vial's addition causes the blood to become irreversibly coagulable, making it unsuitable for hemostasis testing. Similarly, the cells in the serum separator tubes are not accessible for counting. Because of heparin-mediated interference with PB staining, tubes containing lithium heparin as an addition are thus unsuitable for use in haematological assays [13]. Research has indicated that results for activated partial thromboplastin time would exhibit clinical bias if coagulation vials are drawn at less than 89% of the approximate value, and the same is true for fibrinogen if the vials are filled at less than 78%. However, prothrombin time and protein C can still be processed even when the tubes are filled at 67 percent of their defined value [14]. Errors in the sequence of draw, like gathering culture specimens after adding a tube of any type, contaminate the sample and render it unfit for processing [15]. Damage to erythrocytes can be caused by intravascular hemolysis, a pathogenic reason, or by spurious hemolysis, which happens when specimen handling or improper sampling exceeds a threshold value, such as 0.5 g/L of cell-free haemoglobin in the blood [12]. Absorbance-dependent tests may be affected by the breakdown of the red cell membrane by inadvertently increasing other parameters in serum or plasma, such as total protein, LDH, magnesium, Fe, and potassium. High TG samples interfere with absolute analytic concentration, making them unsuitable for accurate amylase, bilirubin, and uric acid measurement [16]. The laboratory personnel should reject these samples since they do not meet the conditions for acceptance. Sample rejection results in higher costs for the laboratory since it necessitates sample collection, repeat testing, and quick inquiry [17]. Moreover, false test results cause misdiagnoses, problems, postponed therapy, and the need for more needless testing, all of which have an adverse effect on patient safety and raise the financial burden on the hospital [8]. According to studies carried out between June and August 2010 in the hospital's clinical laboratory in Porto Alegre. The most common pre-analytical error was shown to be clotted samples, with

a frequency of 43.8%. Hemolysis and insufficient amount were the next most common errors. The chemistry and haematology unit's rejection rate was found to be 0.57% in this experiment [18]. A study conducted at the clinical laboratory in Turkey by I. SINICI Lay et al. categorised the mistakes that result in the rejection of specimens. Retrospective data from the hospital's Laboratory information system was gathered for a full year. The bulk of samples are rejected in the reported rejection ratio of 2.7% because of insufficient specimens (29.3) and blood or fibrin clots (55.8) [19]. Comparably, a one-year study conducted at the HACETTEPE University Hospital reveals a sample rejection ratio of 5.97 percent, with the hemostasis tests contributing to the considerable percentage, or I-e 13.3%. Moreover, Gunner and associates demonstrate that insufficient volume and clot formation were the main causes of the majority of the samples. Another study by Bozdemir and his co-authors, carried out at Duzce University in Turkey, was added to the body of literature. Retrospective data from biochemical, microbiological, and blood transfusion units from 2015 to 2019 shows the rise in rejection rates from 0.88% to 2.12% in a five-year period. The study also assessed the costs associated with reprocessing returned specimens, which are added to hospital expenses annually between 2015 and 2019 at the rates of 0.05%, 0.08%, 0.17%, 0.19%, and 0.24%.

3. CONCLUSION

Medical practitioners rely heavily on diagnostic laboratories to give them vital information for illness diagnosis, management, and therapy. For phlebotomists, identifying patients should be their top goal. Test results may be impacted by partial or total clotting in blood collection tubes, which can be brought on by improper sample and quick vial inversion. For correct diagnosis, the kind of anticoagulants or additives is also crucial. Inaccuracies in the sequence of draws may result in contaminated samples that are inappropriate for processing. Erythrocyte damage from pathogenic reasons or fake hemolysis from improper specimen handling or sampling that exceeds threshold values can also affect absorbance-dependent assays. High TG samples are inappropriate for precise estimate because they obstruct the measurement of absolute analytic concentration. False test findings affect patient safety in the long run and increase the financial burden on the hospital by causing errors in diagnosis, problems, postponed therapy, and needless extra testing. The most common pre-analytical mistake, with a prevalence of 43.8%, is clotted samples.

REFERENCES

[1] Tola E DY DG. Assessment of Types and Frequency of Errors in Diagnostic Laboratories Among Selected Hospitals in East Wollega Zone, Oromia, Ethiopia. Pathology and Laboratory Medicine International. 2022;14:1-6.
[2] Jafari E AM AR. Rates and Reasons of Laboratory Sample Rejection due to Pre-analytical Errors in Clinical Settings. Arch Iran Med. 2022;25(3):166-70.
[3] Ye Y WW ZH, He F, Zhong K, Yuan S, Du Y, Chen B, Wang Z. Haematology specimen acceptability: a national survey in Chinese laboratories. Biochem Med [Zagreb]. 2018;28(3):1-10.
[4] Bozdemir E KM TM. Reprocessing Cost Analysis of Specimens Rejected in Laboratory: Results from the Perspective of the Costs to the Hospital. Clin Exp Health Sci. 2022;12:67-74.
[5] SAWADOGO S NK DB, MINOUNGOU M, KIMA D, KAFANDO E. Knowledge, attitudes and practices of caregivers and laboratory agents on the pre-analytical phase of Haematological analyses in Burkina Faso. IntJBiolChemSci. 2022;16(1):23-33.

[6] Tapper M PJ DL, McGrowder D. Pre-analytical Errors at the Chemical Pathology Laboratory of a Teaching Hospital. Journal of Clinical and Diagnostic Research 2017;11(8):BC16-BC8.
[7] AF. SLIP. Classification of reasons for rejection of biological specimens based on pre-preanalytical processes to identify quality indicators at a university hospital clinical laboratory in Turkey. Clin Biochem. 2014:1-4.
[8] Atay A DL CS, Saglam G, Unal H, Aksun S, Arslan B, Ozkan A, Sutcu R. Clinical biochemistry laboratory rejection rates due to various types of preanalytical error. Biochemia Medica 2014;24(3):376-82.
[9] Guimarães A WM LLBM, Dani C. Causes of rejection of blood samples handled in the clinical laboratory of a University Hospital in Porto Alegre. Clinical Biochemistry 2012;14:123-6.
[10] LippiG GG MC, Plebani M. Preanalytical variability: the dark side of the moon in laboratory testing. Clin Chem Lab Med 2006;44(4):358-65.
[11] Simundic A BG CJ, J.Costelloe S, Lippi G. Managing hemolyzed samples in clinical laboratories. Critical Reviews in Clinical Laboratory Sciences. 2019:1-21.
[12] Lippi G VMA CJaSA. Blood Sample Quality. Diagnosis 2019;6(1):25-31.
[13] Dikmen Z PA AF. Specimen rejection in laboratory medicine: Necessary for patient safety? Biochemia Medica 2015;25(3):377-85.
[14] Lippi G SA MC. Lippi G SA, Mattiuzzi C. Over view on Patient Safety in healthcare and labortary diagnostics. Biochemia Medica 2010;20(2):131-43.
[15] Kamal F SW AMM, Rahmat M. Analysis of Sample Rejection and the Impact on Quality of Care in Patients in a Single Tertiary Healthcare Facility in Malaysia. E-BPJ. 2020;5(13):175-81.
[16] Bozdemir E KM TM. Reprocessing Cost Analysis of Specimens Rejected in Laboratory: Results from the Perspective of the Costs to the Hospital. Clin Exp Health Sci. 2022;12:67-74.
[17] SAWADOGO S NK DB, MINOUNGOU M, KIMA D, KAFANDO E. Knowledge, attitudes and practices of caregivers and laboratory agents on the pre-analytical phase of Haematological analyses in Burkina Faso. IntJBiolChemSci. 2022;16(1):23-33.
[18] Tapper M PJ DL, McGrowder D. Pre-analytical Errors at the Chemical Pathology Laboratory of a Teaching Hospital. Journal of Clinical and Diagnostic Research 2017;11(8):BC16-BC8.
[19] AF. SLIP. Classification of reasons for rejection of biological specimens based on pre-preanalytical processes to identify quality indicators at a university hospital clinical laboratory in Turkey. Clin Biochem. 2014:1-4.

