Cross Current International Journal of Medical and Biosciences
Abbreviated Key Title: Cross Current Int J Med Biosci
ISSN: 2663-2446 (Print) & Open Access

OPEN ACCESS

Volume-2 | Issue-4 | April, 2020 |

Research Article

Pattern of Blood Specimen Rejection at a Nigerian Public Clinical Laboratory

Abubakar Umar Musa and Muhammad Alhaji Ndakotsu

Department of Haematology and Blood Transfusion, Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, Northwest

***Corresponding author:**
Abubakar Umar Musa

E-mail: abubakarumar38@yahoo.com

Received: 06.04.2020
Accepted: 25.04.2020
Published: 29.04.2020

Abstracts: Obtaining appropriate blood specimen is central towards provision of reliable results in a clinical laboratory. To ensure that blood specimen collected for analysis reflect the physiologic or pathologic processes they represent, potential sources of pre-analytic errors should be identified and avoided. Our study aimed at determining the pattern of blood specimen rejection in a public clinical laboratory with a view of identifying inadequacies that should be improved upon. The sample rejection register at the Haematology laboratory of Usmanu Danfodiyo University Teaching Hospital Sokoto, Northwest Nigeria was accessed for a two-year period data on number of specimens rejected, reasons for rejection, types of tests for which rejections were made and affected clinical units; and the retrieved data were analysed using Microsoft Excel 2010. Of the 53,955 specimens received during the study period, 122 were rejected giving an overall specimen rejection rate of 0.23%. Incomplete specimen labelling and clotted specimens were the commonest reasons for specimen rejection having accounted for 59.8% (73) and 30.3% (37) of the rejections respectively. Coagulation Screening Tests and Packed Cell Volume had the highest rejection rates of 52.5% (64) and 18.0% (22) respectively. The Accident and Emergency (A&E) and Emergency Paediatric Unit (EPU) recorded the highest rates of sample rejection with 31.1% (37) and 11.8% (14) rejection rates respectively. We concluded that the reasons for blood specimen rejection in our public clinical laboratory could be avoided via the use of appropriate and properly labelled specimen containers and avoidance of faults in specimen collection, storage and transportation to the laboratory.

Keywords: Clinical laboratory, specimen, rejection, pre-analytic phase, error, Sokoto.

INTRODUCTION:

A laboratory error is defined as 'any failure of planned action to be completed as intended, or use of a wrong plan to achieve an aim, occurring at any part of the laboratory cycle, from ordering examinations to reporting results and appropriately interpreting and reacting to them' (ISO, 2008). The occurrence of errors in the clinical laboratory has been associated with significant detrimental effects that may eventually translate into poor clinical and financial outcomes in patient management (Lippi *et al.,* 2009; Green 2013; Lewis *et al.,* 2006). Laboratory errors are traditionally classified as pre-analytical, analytical and post-analytical depending on the part of the laboratory cycle during which they occur. Most laboratory errors do occur within the pre-analytical phase (Goswani *et al.,* 2010; Akan *et al.,* 2006; Bonini *et al.,* 2002) probably due to the large number of health workers, with varying technical skills, involved in specimen collection, handling, transportation, preparation and storage (Akan *et al.,* 2006; Sharma 2009). Furthermore the mitigating roles played by advances in automation technology on occurrence of pre-analytical phase errors are not well pronounced when compared with effects of same on errors occurring within the other phases of the laboratory cycle. Measures put in place towards averting pre-analytical errors include the provision of

Quick Response Code

DOI : 10.36344/ccijmb.2020.v02i04.003

Journal homepage:
http://crosscurrentpublisher.com/ccijmb/

pre-analytical standardization guidelines, specimen rejection criteria, modern robotic technologies and information system (Lillo *et al.*, 2012; Hammerling 2012). Thus, this study determined the pattern of blood specimen rejection recorded during the pre-analytical phase at a Nigerian public clinical laboratory and proffered measures to be instituted towards improving the situation.

Experimental section:

The Haematology laboratory at the department of Haematology and Blood Transfusion serves both in-patients and out-patients from the clinical departments of Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, which is a 700-bedded tertiary hospital located in the Northwest Nigeria. Our study was conducted at the general haematology section of the laboratory which didn't include the blood bank. All specimens reaching the laboratory are subjected to rejection criteria before acceptance and subsequent registration into the Haematology Day Sheet Register at the reception of the laboratory. Staff at the laboratory reception has been trained to apply the rejection criteria to all specimen submitted for analysis. The specimen rejection criteria employed by the laboratory include:

- Incomplete/improper labeling of specimen containers
- Specimen not accompanied with test request forms
- Clotted sample
- Haemolyzed sample
- Insufficient sample
- Excess sample
- Wrong blood to anticoagulant ratio
- Inappropriate sample container
- Lipaemic sample
- Samples that have overstayed before reaching the laboratory such as sample collected overnight and not properly stored.

The hard copy of the sample rejection register of the Haematology laboratory at the department of Haematology and Blood Transfusion, Usmanu Danfodiyo University Teaching Hospital (UDUTH) Sokoto, Northwest Nigeria was accessed. Records spanning a two-year period (1st January 2016 to 31st December 2017) were retrieved and data on number of specimens rejected, reasons for rejection, types of tests for which rejections were made and affected clinical units were retrieved. The extracted data were entered into Microsoft Office Excel 2010 and analysed while results were expressed in simple proportions and percentages.

RESULTS:

A total of 53,955 blood specimens were received during the two-year study period while 122 rejections were made giving an overall specimen rejection rate of 0.23% for the laboratory as depicted in Table I.

Table I: Annual Sample Rejection Rate for the Laboratory during the Study Period

	YEAR		TOTAL
	2016	**2017**	
Samples Collected	29,651	24,304	53,955
Samples Rejected	55	67	122
Rejection Rate	0.19%	0.28%	0.23%

Incomplete specimen labelling and clotted specimens were the commonest reasons for specimen rejection having accounted for (73) 59.8% and (37) 30.3% of the rejections respectively. Additional reasons for blood specimen rejection encountered in the study are as shown in Table II.

Table II: Reasons for Specimen Rejections

Reason for Rejection	**Year 2016 n**	**Year 2017 n**	**TOTAL n (%)**
Incomplete/improper labelling	35	38	73 (59.8)
Clotted sample	15	22	37 (30.3)
Unlabelled & clotted	1	4	5 (4.1)
Insufficient sample	2	1	3 (2.5)
Inappropriate sample container	2	1	3 (2.5)
Excess sample	0	1	1(0.8)
Total	55	67	122 (100)

Coagulation screening requests and Packed Cell Volume estimation had the highest specimen rejection rates. Table III give a highlight on the rejection rates of the various tests that had rejections at the public clinical laboratory.

Table III: Specimen Rejection Rates According to the Tests Requested

Type of Test	YEAR		Total
	2016 n	2017 n	n (%)
Full Blood Count	5	8	13 (10.7)
Packed Cell Volume	8	14	22 (18.0)
Prothrombin Time	16	20	36 (29.5)
Activated Partial Thromboplastin Time	13	15	28 (23.0)
Peripheral Blood Film	5	5	10 (8.2)
Erythrocyte Sedimentation Rate	7	5	12 (9.8)
Haemoglobin Electrophoresis	1	0	1 (0.80)
Total	**55**	**67**	**122 (100)**

The Accident and Emergency (A&E) and Emergency Paediatric Unit (EPU) of the hospital recorded the highest rates of sample rejection with (37) 31.1% and (14) 11.8% rejection rates respectively. Tables IV and V give the breakdown and summary of the rejection rates according to clinical units and departments.

Table IV: Rejection Rates based on Clinical Units

Clinical Unit	2016 (n)	2017 (n)	TOTAL n (%)
Surgery			
Accident and Emergency	15	22	37 (31.09)
Surgery Out-Patient Clinic	1	0	1 (0.84)
Female Surgical Ward	2	0	2 (1.68)
Male Surgical Ward	1	2	3 (2.52)
Urology Ward	0	2	2 (1.68)
Orthopaedic Ward	0	2	2 (1.68)
Ear, Nose and Throat Ward	1	1	2 (1.68)
Trauma Centre	2	1	3 (2.52)
Paediatric Surgical Ward	4	2	6 (5.04)
Trauma Ward	1	0	1 (0.84)
Female Neurosurgery Ward	0	2	2 (1.68)
Paediatric Neurosurgery Ward	3	1	2 (1.68)
Radiotherapy Ward	1	1	2 (1.68)
Ophthalmology Ward	1	0	1 (0.84)
Total	32	36	68
Medicine			
Male Medical Ward	5	4	9 (7.56)
Medical Out-Patient Clinic	1	0	1 (0.84)
General Out-Patient Clinic	1	1	2 (1.68)
National Health Insurance Scheme Clinic	0	1	1 (0.84)
Haematology Day Care	0	1	1 (0.84)
Total	7	7	14
Paediatrics			
Paediatric Medical Ward	2	1	3 (2.52)
Special Care Baby Unit	0	1	1 (0.84)
Emergency Paediatric Unit	7	7	14 (11.8)
Paediatric Out-Patient Unit	0	1	1 (0.84)
Sickle Cell Clinic	0	2	2 (1.68)
Total	9	12	21
Obst & Gynae			
Main Labour Room	0	2	2 (1.68)
Post Natal Clinic	0	1	1 (0.84)
Post Natal Ward	1	1	2 (1.68)
Prenatal Ward	1	1	2 (1.68)
Gynaecology Emergency Clinic	2	4	6 (5.04)
Gynaecology Ward	1	1	2 (1.68)
Total	5	10	15
Grand Total	**53**	**66**	**119 (100)**

NB: Three (3) out of the total (122) rejected specimen had no clinical unit/department indicated on either their specimen bottles or accompanying request forms.

Table V: Summary of Rejection Rates based on Clinical Departments

Clinical Unit	2016 n	2017 n	TOTAL n (%)
Surgery	32	36	68 (54.6)
Paediatrics	9	12	21 (17.6)
Medicine	7	7	14 (13.4)
Obstetrics & Gynaecology	5	10	15 (11.8)
Total	53	66	119 (100)

DISCUSSION:

The preanalytical phase in the clinical laboratory is defined as comprising of 'processes that start, in chronological order, from the clinician's request and include the examination request, preparation and identification of the patient, collection of the primary sample(s), and transportation to and within the laboratory, and end when the analytical examination begins' (ISO 2012; Dikmen *et al.*,2015). The preanalytical phase has further been partitioned into pre-preanalytical and preanalytical sub-phases; while the former comprises of steps involved in test request, patient or sample identification, sample collection, handling and transportation, the latter sub-phase has to do with the processes of sample preparation for analysis such as centrifugation, aliquoting and sorting (Plebani *et al.,2012*; Dikmen *et al.,* 2015). Numerous works have shown that most clinical laboratory errors occur within the pre-preanalytical phase (Goswani *et al.,* 2010; Akan *et al.,* 2006; Dikmen *et al.,* 2015; Bonini *et al.,* 2002) largely due to the involvement of a large number of health workers that are not within the control of the laboratory (Akan *et al.,* 2006; Sharma 2009; Dikmen *et al.,* 2015).

Our study found an overall specimen rejection rate of 0.23% which is lower than the 6% and 0.9% recorded by Dikmen *et al.,* 2015 in Turkey and Goswani *et al.,* 2010 in India respectively; the varying rates observed in the studies maybe related to the quantity of requests from emergency units, availability and compliance with preanalytical standardization guidelines and adherence to standard rejection criteria. Earlier works have shown that the utilization of preanalytical standardization guidelines, documentation of rejection samples and periodic training of healthcare workers on identification and avoidance of sources of errors do significantly reduce the incidence of errors occurring within the preanalytical (Lippi *et al.,* 2006; Dikmen *et al.,* 2015).

Both our study and that of Dikmen recorded highest rejection rates with the emergency units of the hospitals; while we reported a rejection rate of 42.9% (31.1% for Accident and Emergency and 11.8% for Emergency Paediatric Unit); the Dikmen study recorded 41.0% (31.0% for Adult Emergency Department and 10.0% for Paediatric Emergency Department). This finding at the emergency units may not be unconnected with peculiar challenges of patients' care encountered therein such as unstable patients with difficult venous access and distractions from observing standard sample collection procedures such as taking adequate blood volume, observing recommended blood to anticoagulant ratio, gently shaking specimen containers to ensure mixing of blood and anticoagulant as well as proper labelling of specimen containers with patients' information.

We recorded incomplete or improper labelling of specimen as the commonest reason for specimen rejection accounting for up to 59.8% at our laboratory and this contrasts the paltry 0.3% contribution by misidentification found by the Dikmen study. Our finding is quite high and reflects the large potential for the occurrence of preanalytical errors as a result of specimen misidentification. It is worthy of note that, errors related to patients, specimens and laboratory testing identification can be greatly minimized via the use of electronic barcoding system as is the practise at the Hacettepe University Hospital where the Dikmen study was conducted. In centres like ours where the barcoding system isn't yet available, it is advisable that information such as patient's names and hospital number should be reflected on specimen container as well as ensuring that there is matching between tests request forms and specimen submitted to the laboratory.

In contrasts to our findings, quite a number of studies have identified haemolysis as the commonest cause of specimen rejection as it could influence accuracy and reliability of laboratory testing. The prevalence of haemolysis could be as high as 40-70% of all unsuitable specimens identified in a laboratory (Lippi *et al.,* 2009). Goswami *et al.,* 2010, reported haemolysed specimen as the most common encountered problem having led to 81% of specimen rejection and this was followed by insufficient volume of specimen submitted for analysis and incomplete patient information.

In our study, clotted sample was the second commonest reason for specimen rejection having accounted for 30.3% rejections while unlabelled and clotted samples as well as insufficient sample were third

and fourth commonest reasons with 4.1% and 2.5% rejections respectively. Presence of clots in specimen was the major reason for specimen rejection for both Biochemistry and Coagulation tests in the Dikmen study followed by insufficient specimen. We also noted in our study that Coagulation tests (Prothrombin Time and Activated Partial Thromboplastin Time) were the major tests associated with the highest specimen rejections of 52.5%.The high occurrence of clots in specimen submitted for analysis especially for coagulation tests as observed by both studies could be attributed to non- or improper mixing of specimen immediately after collection into specimen containers. Additional reason include inappropriate specimen to anticoagulant ratio which may be difficult to maintain in the setting of non-use of evacuated tube system as obtained in our centre of study where the traditional syringe/needle/container system still abound.

From the foregoing it is obvious that source of errors within the preanalytical phase are still rife in clinical laboratories and their prevalence in a particular laboratory is dependent on how well or otherwise standard precautionary measures are put in place against their occurrence. Considering the negative impact of the occurrence of such errors on the totality of patient health care management, all efforts are expected to be put in place towards averting the occurrence of these errors. Lillo and colleagues have demonstrated how preanalytical laboratory sample errors could be reduced via introduction of educational and technological interventions in the laboratories (Lillo *et al.*, 2012). Other workers had equally shown how quality-improvement measures such as documentation of specimen rejection criteria and use of preanalytical standardization guidelines could go a long way in minimizing the occurrence of preanalytical errors in the clinical laboratories (Agarwal 2014; Lillo *et al.*, 2012).

CONCLUSION:

The major reasons for blood specimen rejection at our public clinical laboratory were incomplete labelling of specimen containers and clotted specimens submitted for analysis. Such occurrences could be avoided via the use of appropriate and properly labelled specimen containers, avoidance of faults in specimen collection, storage and transportation to the laboratory. Clinical laboratories should also provide preanalytical standardization guidelines and specimen rejection criteria for staff and users of their laboratories to serve as guides towards avoidance of pre-analytical errors in the laboratories.

REFERENCES:

1. Agarwal, R. (2014). Quality-improvement measures as effective ways of preventing laboratory errors. *Laboratory Medicine*, *45*(2), e80-e88.
2. Akan, Ö. A., Elmali, E., & Karaeren, Z. (2006). Evaluation of preanalytic errors in clinical laboratory practice. *Laboratory Medicine*, *37*(8), 478-480.
3. Bonini, P., Plebani, M., Ceriotti, F., & Rubboli, F. (2002). Errors in laboratory medicine. *Clinical chemistry*, *48*(5), 691-698.
4. Goswami, B., Singh, B., Chawla, R., & Mallika, V. (2010). Evaluation of errors in a clinical laboratory: a one-year experience. *Clinical chemistry and laboratory medicine*, *48*(1), 63-66.
5. Green, S. F. (2013). The cost of poor blood specimen quality and errors in preanalytical processes. *Clinical biochemistry*, *46*(13-14), 1175-1179.
6. Gunnur Dikmen, Z., Pinar, A., & Akbiyik, F. (2015). Specimen rejection in laboratory medicine: Necessary for patient safety?. *Biochemia medica: Biochemia medica*, *25*(3), 377-385.
7. Hammerling, J. A. (2012). A review of medical errors in laboratory diagnostics and where we are today. *Laboratory medicine*, *43*(2), 41-44.
8. International Organization for Standardization (2012). Medical Laboratories: Particular Requirements for Quality and Competence ISO 15189. Geneva, Switzerland.
9. International Organization for Standardization/Technical Specification (2008). Medical Laboratories- Reduction of Error through Risk Management and Continual Improvement. ISO/TS 22367
10. Lewis, S.M., & Tatsumi, N. (2006). Collection and Handling of Blood. In: Lewis SM, Bain BJ, Bates I (eds). Dacie and Lewis Practical Haematology 10th edition. Churchill Livingstone Publishers Philadelphia, 379-440.
11. Lillo, R., Salinas, M., López Garrigós, M., Naranjo Santana, Y., Gutiérrez, M., Marín, M. D., ... & Uris Sellés, J. (2012). Reducing Preanalytical Laboratory Sample Errors Through Educational and Technological Interventions. *Clin Lab* 58, 1-7.
12. Lippi, G., Blanckaert, N., Bonini, P., Green, S., Kitchen, S., Palicka, V., ... & Plebani, M. (2009). Causes, consequences, detection, and prevention of identification errors in laboratory diagnostics. *Clinical chemistry and laboratory medicine*, *47*(2), 143-153.
13. Plebani, M. (2012). Quality indicators to detect pre-analytical errors in laboratory testing. *The Clinical Biochemist Reviews*, *33*(3), 85-88.
14. Sharma, P. (2009). Preanalytical variables and laboratory performance. *Indian Journal of Clinical Biochemistry*, *24*(2), 109-110.