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Research Article

A Study on Sample Rejection Rates due to Pre-analytical Errors: Associated Factors and Knowledge, Attitudes and Practices of Nurses on Blood Sample Collection for Haematology at a Teaching Hospital in Sri Lanka

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Abstract

Introduction: Clinical diagnosis is mostly dependent on laboratory test results. Studies have shown that 70% of clinical laboratory samples are rejected due to pre-analytical errors. This study was conducted to assess; rejection rates of blood samples, major reasons for rejection of blood samples, and knowledge, attitudes and practice of nurses on blood sample collection. Methods: Details of rejected blood samples were collected using data sheets of rejected blood specimens at the Teaching Hospital Karapitiya, Sri Lanka. Knowledge, attitudes and practices of nursing officers on blood sample collection were assessed using a self-administered questionnaire. Data were analyzed using SPSS version 22. Results: Overall blood sample rejection rate was 3.3%. The major cause of rejection of blood samples was the clotting of specimens. Insufficient volume, hemolysis, unavailability of request form for investigation, discrepancies in bed head tickets, discrepancies of the names, and use of IV line for blood collection were among the other reasons for sample rejection. The highest rejection rate was reported from the samples obtained for Prothrombin time/International Normalized Ratio (PT/INR) test. According to the scores obtained for knowledge of the nurses on blood sample collection, 43% of them scored 'average' while 38% scored 'good'. The nurses' attitudes on blood sample collection were satisfactory. Conclusions: Overall rejection rate was higher in the Haematology Laboratory of Teaching Hospital Karapitiya compared to the values reported elsewhere. Although the overall knowledge of nurses was satisfactory regarding blood sample collection, aspects such as knowledge on the correct volume of blood needed for specific investigations, choosing a suitable site for blood drawing, and practices such as the provision of duly filled investigation forms need to be improved.

Keywords: Rejection rate, Pre-analytical error, Haematology, Blood, Sample collection

Introduction

The effective patient management depends on the accuracy of laboratory results [1]. Clinical laboratory plays an increasingly important role in the patient-centered approach of delivering of health-care services. The haematology laboratory is one of the main components in the clinical laboratory set up [2]. Clinical laboratory errors directly lead to increased healthcare costs due to misleading disease diagnosis. It increases

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sample collection frequencies, delays the releasing of results, and decreases patient satisfaction. A laboratory error is defined as any defect that occurs during the entire testing process, from ordering tests to reporting results that in any way influence the quality of laboratory services [3].

Pre-analytical errors cause discomfort to the patient and it causes a negative influence on the image of the healthcare team. Therefore, assessing the rejection rates and identifying the causes for rejections are important for minimizing errors. In addition, it is necessary to identify whether there is an influence between the knowledge and practice of nursing officers who collect blood samples on the rejection rate. There is limited literature available regarding the rejection of haematology blood samples and there are no published data available regarding the above aspect in Sri Lanka.

The present study was undertaken at the Teaching Hospital, Karapitiya, Sri Lanka to identify the rejection rates of haematology blood samples, to identify the related pre-analytical errors, and to ascertain the knowledge, attitudes and practices of nursing staff regarding blood sample collection. Teaching Hospital Karapitiya is the largest tertiary care center in the Southern Province of Sri Lanka.

Methods

Study design

This cross-sectional study comprised of two parts. Part 1 was conducted to determine the sample rejection rates at the Haematology Laboratory of the Teaching Hospital Karapitiya, Sri Lanka.

Part 2 of the study intended to assess knowledge, attitudes and practices of nurses of the same hospital on blood sample collection during the same time frame (as in Part 1) assuming that those rejected samples were collected by these nurses.

Data collection

Part 1: Details of rejected blood samples were recorded using data sheets for each rejected specimen. Data collection was done on 20 consecutive weekdays in a month, from 8.00 a.m. to 4.00 p.m. Rejection rates were calculated using the following formula.

$$\text{The sample rejection rate} = \frac{[\text{Number of samples rejected}] \times 100}{[\text{The total number of samples received}]}$$

The total sample rejection rate, rejection rates according to the rejection criteria and rejection rates according to the investigation were calculated.

Part 2: A purposive convenient sample of 200 nurses who were working in the medical, surgical, pediatric and Emergency Trauma Unit (ETU) at the Teaching Hospital Karapitiya, Sri Lanka were used for the study. Data was collected using a pre-tested self-administered questionnaire.

Statistical Analysis

Scores were categorized as poor (below 50%), average (50% to 70%), good (70% to 85%) and excellent (above 85%) levels. Demographic data were analyzed using descriptive analysis. Statistical analysis was performed using student's t test and one-way ANOVA by Statistical Package for Social Sciences (SPSS) version 22. The p value <0.05 was considered as significant.

Ethical Approval

The ethical approval for the study was obtained from the Ethical Review Committee, Faculty of Medicine, University of Ruhuna, Sri Lanka (Ref No:14.12.2015:3.12).

Results

Part 1

A total of 12506 samples were received in the Haematology Laboratory within 20 consecutive weekdays and among them, 417 (3.33%) were rejected. The sample rejection rate of observed samples, according to the cause of rejection is shown in Table 1. Among the several rejection criteria, the majority of blood samples were rejected due to clot formation (60.0%).

The observed sample rejection rates according to the investigation requests are shown in Table 2. The highest rejection rate (6.7%) was found for requests made for Prothrombin time/International Normalized Ratio (PT/INR).

Table 1: Rejection rates according to the cause of rejection

Rejection criteria	Number of samples rejected	Rejection rate (%)
Insufficient volume	45	10.8
Overfilled	41	9.8
Clotted	250	60.0
Hemolysis	42	10.0
Unclear request forms	2	0.4
Unclearly labeled	1	0.2
Empty tubes	2	0.5
No request form for specimen	11	2.6
No BHT number	3	0.7
Name discrepancies	4	1.0
BHT discrepancies	10	2.4
Investigation differences	1	0.2
Taken from IV line	2	0.5
No ward number on the request form and tube	3	0.7
Total	417	

BHT- Bed Head Ticket, IV- Intravenous

Table 2: Sample rejection rate according to the investigation

Investigation requested (as per the request form)	Number of samples received	Number of samples rejected	Rejection rate (%)
FBC	7862	115	1.5
BP	1049	11	1.0
PT/INR	2728	184	6.7
APTT	207	7	3.4
ESR	1819	113	6.2
Reticulocyte count	43	1	2.3
Hb	1	0	0.0

FBC- Full Blood Count, BP- Blood Picture, PT/INR- Prothrombin Time/International Normalized Ratio, APTT- Activated Partial Thromboplastin Time, ESR- Erythrocyte Sedimentation Rate, Hb-Haemoglobin

When considering the age groups of the patients, the highest rejection rate was found with the samples collected from the age group of above 55 years (24.9%).

The highest number of rejected samples were from medical wards (43.4%). The rejection rates of blood samples obtained from surgical wards, pediatrics wards, ETU and other wards [oncology, Ear, Nose and Throat (ENT), Coronary Care Unit (CCU), Operation Theatre (OT) and clinics] were 24.0%, 6.2%, 13.0% and 24.0%, respectively. Further, 0.2% of the rejected samples were found without any ward number.

Part 2

A total of 200 nursing officers from medical, surgical, pediatrics and ETU wards/units of the Teaching Hospital Karapitiya participated for the study. The demographic characteristics of the study population are indicated in Table 3.

The scores obtained on the knowledge on blood sample collection was normally distributed. The mean score of the knowledge was 66.79±12.77. Among the participants, only 5.5% (n=11) were in the excellent level, 38.0% (n=76) were in the good level, 43.0% (n=86) were in the average level and 13.5% (n=27) were in the poor level.

Associated factors for the scores of knowledge on blood sample collection are indicated in Table 4. There was a statistically significant difference in the knowledge scores between the nurses in different educational groups as determined by one-way ANOVA. The Least Significant Difference (LSD) Post Hoc Test revealed that the scores obtained for the knowledge on blood

Table 3: Demographic characteristics of nurses who participated in the study (n=200)

Demographic characteristics		Percentage (%)
Gender	Female	92.0
	Male	08.0
Age (years)	20-30	20.5
	30-40	54.5
	40-50	21.0
	>50	05.0
Ward/Clinic	Medical	36.0
	Surgical	30.5
	Pediatric	17.5
	ETU	16.0
Educational level	Diploma	88.0
	Undergraduate	07.5
	Graduate	04.5
Work experience (years)	< 1	1.0
	1-5	16.5
	>5	82.5
Internet usage for acquiring new knowledge	Yes	42.5
	No	57.5

ETU- Emergency Trauma Unit

sample collection is significantly higher in undergraduates (75.17±12.97) compared to the diploma holders (66.08±12.58, p=0.008). However, there was no significant difference in the knowledge on blood sample collection among the graduated nurses (66.63±12.60) and the group with nursing diploma (p=0.899) or the group with undergraduate qualifications (p=0.110).

The knowledge scores among nurses, based on their work experience was not statistically significant (F (2,197)=1.802, p=0.168). However, there was a statistically significant difference in the knowledge scores of nurses according to the ward they practiced (F (3,196)=3.035, p=0.030). LSD Post Hoc Test revealed that knowledge score was significantly higher in the nurses at ETU (72.83±11.18) compared to that of the medical wards (66.30±10.59, p=0.016), surgical wards (65.23±13.10, p=0.006) and pediatrics ward (65.02±16.16). No significantly different scores for knowledge on blood sample collection was observed among nurses who use internet to update knowledge and those who do not (p>0.05). Knowledge scores of the nurses were also not significantly different based on their age or gender.

About 98.0% (n=196) of nurses added blood into the tube after removing the needle correctly. However, 2.0% (n=4) of nurses used the wrong practice. About 46.5% (n=93) of the nurses strongly agreed that it is very important to find out the reason, if a blood sample has been

Table 4: Associated factors with knowledge scores among nurses

Comparison groups		Mean±SD
Educational level	Diploma	66.08±12.58[a]
	Undergraduate	75.17±12.97[a]
	Graduate	66.63±12.60
Work experience (years)	<1	64.00±11.03
	1-5	63.04±15.21
	>5	67.58±12.19
Ward/Clinic	Medical	66.30±10.59[b]
	Surgical	65.23±13.10[c]
	Pediatric	65.02±16.16[d]
	ETU	72.83±11.18[b, c, d]
Internet usage for new knowledge	Yes	68.83±13.26
	No	65.29±12.29
Age group (years)	20-30	64.45±16.03
	30-40	67.37±11.94
	40-50	67.50±11.38
	>50	67.24±13.12
Gender	Female	66.34±12.89
	Male	72.01±10.26

[a] p=0.008, [b] p=0.016, [c] p= 0.006, [d] p= 0.012

ETU- Emergency Trauma Unit, SD- Standard Deviation

rejected from the laboratory while 52.0% (n=104) mentioned "agreed" to the same. Overall, 98.5% of nurses had positive attitudes toward finding out the reason for rejection to prevent further rejection and 69.5% (n=139) of nurses do not think that blood drawing is stressful for them. The majority of nurses, 57.5% (n=115) disagreed to delegate the blood drawing procedure to phlebotomists. This shows their willingness to undertake and fulfill the responsibility.

Common problems regarding blood sample collection as mentioned by nurses included lack of suitable sized needles and syringes to collect different volumes of blood. Other problems they faced were; inadequate specimen containers, heavy workload, difficulty of finding veins from chronic patients and frequent physician requests for investigations on the same patient.

The suggestions from nurses for the problems they faced were; arrange educational sessions to provide new knowledge, inform the reasons for rejecting the samples by the laboratory, provide sufficient minor staff, provide adequate facilities (specimen containers and syringes) and display a poster with relevant information for sample collection.

Discussion

Modern clinical diagnosis is highly defendant on reliable laboratory data [4]. The rejection of unsuitable samples leads to delayed turnaround time and affect patient care [5]. The total sample rejection rate indicated by the present study was 3.3%. In a study conducted in a tertiary laboratory in Cape Town, Africa, out of total of 32,910 specimens that had been received during the study period, a rejection rate of 1.46% have been recorded [5]. The total sample rejection rate in the present study is higher than the above study.

In the present study, out of all the rejected samples, 60.0% of samples were rejected due to clot formation. From the rejected samples (n=184) taken for PT/INR test, about 90.0% samples were rejected due to clot formation. Reasons for clot formations may be due to overfilling, use of insufficient anticoagulants, or inappropriate mixing of samples.

The highest rejection rate was found among the samples sent for PT/INR test (6.7%). The majority of rejected samples were reported from medical wards. A similar study carried out at Prince Hamzah Hospital in Amman [6]**,** had also observed the highest rejection rate from the medical ward throughout their study period ranging from 33.0% to 58.0%.

The sample rejection rate of patients above 55 years and between 40 to 55 years old was 25.0% and 16.3% respectively. This may be due to patients having chronic diseases and therefore, difficulty may experience in finding veins due to frequent blood withdrawals. However, the age of the patient was not mentioned in 44.3% of the request forms.

The majority of nurses have positive attitudes to find out the reasons for rejection to prevent further malpractices. The majority of nurses willingly participate in blood drawing as only 1.5% of nurses said that blood drawing is stressful.

The overall knowledge of nurses on blood sample collection was satisfactory. Although the overall knowledge of blood sample collection was good, the sample rejection rate was high. This study shows that knowledge of nurses still needs to be improved in some aspects such as the amount of blood volume needed for relevant specimens, suitable container for relevant investigations, mixing of anticoagulant and blood in the specimen container, and suitable venous access for blood drawing.

Limitations

This study was conducted using only one laboratory in a government hospital, hence the findings may not provide the overall rejection rates of haematology blood samples of the healthcare system of the country. Use of 200 nursing officers from selected wards to assess the knowledge, attitudes and practices of nursing staff regarding blood sample collection is also a limitation in this study.

Conclusions

The overall sample rejection rate of the haematology laboratory of the Teaching Hospital Karapitiya was 3.33%. Clot formation was the major cause for sample rejection. The highest rejection rate was reported for requests made for PT/INR, ESR and APTT tests. The knowledge of nurses regarding sample collection was satisfactory. The knowledge of nurses regarding some aspects of the blood sample collection needs to be improved. Overall attitudes of nurses on blood sample collection are satisfactory. The value of continued education and training programs for nurses to enhance the quality of blood sample collection and evaluation of their effectiveness is emphasized.

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