

Original Research Article

Comparison of knowledge, attitude and practices in routine blood and urine collection among final year laboratory technician students, nursing students and house surgeons

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ABSTRACT

Background: Laboratory services are the backbone of the modern health care sector. In spite of rapid advances in laboratory science, it is still susceptible to various manual and systemic errors. Pre-analytical phase includes specimen collection, storage, separation and transport. Errors in this phase are majorly due to human mistakes and the majority of these errors are preventable. Laboratory technicians and nursing staff from in-patient care are most commonly and directly involved in sample collection. There are many studies done using them as study population. However, the role of physician in sample collection techniques is often ignored. Ideally a doctor should also be aware of the sample collection techniques and anticipate possible lab errors due to pre-analytical error.

Methods: A quantitative cross sectional comparative study with 60 participants comprising 20 each from house surgeons, final year lab technicians and nursing students in a tertiary care hospital. A pre-tested, self-administered and validated questionnaire was used to assess knowledge, attitude and practices in routine blood and urine collection with total 27 questions. Statistical analysis: ANOVA, student's t- test and qualitative analysis was done.

Results: In the area of sample collection techniques house surgeons lacked the required knowledge compared to nursing and lab technician students and it was also reflected in sample collection practices.

Conclusions: Based on the study, we strongly opine to train MBBS students in routine blood collection techniques and sensitize them to pre analytical errors which will help in reducing lab reporting errors.

Keywords: Blood, House surgeons, Lab technician students, Nursing students, Pre analytical errors

INTRODUCTION

Laboratory services are the backbone of the modern health care sector. In spite of rapid advances in laboratory science, it is still susceptible to various manual and systemic errors. Various types of errors that clinical biochemists, encounter in the laboratory are classified as pre-analytical, analytical, and post-analytical, depending upon the time of presentation. The pre-analytical phase is an important component of laboratory medicine and most errors occur in the pre-analytical phase affecting the

results.¹ Proper collection, processing and storage of common sample types associated with requests for diagnostic testing are critical in providing quality test results and many errors can occur during these steps. Such errors are considered pre-analytical errors and are known to contribute to delayed and suboptimal patient care.

Errors in sample collection can result in grave consequences. For example, errors in measuring myokines for assessing cardiovascular diseases may fail

to detect the disease.² Likewise, there are potential misdiagnoses due to mixing of thawed plasma.³

The impact of delayed sample handling on interpretation of dysplastic signs has been studied. The sampling processes cause considerable immune phenotypic alterations which can lead to false interpretations of results.⁴

Recognizing and minimizing these errors through careful adherence to any individual institutional policies will result in more reliable information for use in quality patient care by healthcare professionals.⁵

In recent times, there has been a significant decrease in the rates of analytical errors in clinical laboratories. However, it has been estimated that up to 62% errors happen during pre-analytical phase.⁶

Pre-analytical phase includes specimen collection, storage, separation and transport. Errors in this phase are majorly due to human mistakes and the majority of these errors are preventable.^{7,8}

To improve the patient safety in laboratory testing, all healthcare providers should survey their pre-analytical procedures and improve the total testing process with a systems perspective. Pre-analytical error prevention requires excellent communication and co-operation among all members of the health care team.⁹

Laboratory technicians and nursing staff from in-patient care are most commonly and directly involved in sample collection. There are many studies done using them as study population. However, the role of the physician in sample collection techniques is often ignored. Ideally, a doctor should also be aware of the sample collection techniques and anticipate possible lab errors due to pre-analytical errors as a possibility. Since most of the doctors currently just play indirect roles of ordering particular blood test, knowledge on pre-analytical errors with routine sample collection techniques can definitely help doctors in preventing the possible lab errors in the test reports due to pre-analytical errors.¹⁰

Quite a number of studies have been conducted on errors in blood collection; analysing the errors in pre-analytical, analytical and post analytical phases. Study conducted by Lalongo and Bernardini showed that as far as 36 studies were done on pre-analytical errors from 1996-2016.¹¹

A questionnaire based study for improving blood sample collection and patient identification was done by Wallin et al. The study was one among the first of its kind to compare two different medical disciplines-lab staff and nurses.¹²

Many studies have been done on quality improvement for reducing errors.¹³⁻¹⁵ However, a study on medical students has not been carried out and neither has a study

been done to compare the clinical (nursing) and para-medical (lab technicians) staff with medical students.

Therefore, the present study was planned with the purpose of assessing knowledge, attitude, and practices on routine blood and urine collection techniques among laboratory technician students, nursing students and house surgeons and to compare these parameters among the three groups.

METHODS

A quantitative and qualitative cross sectional comparative study among Health care professionals including students of laboratory technician courses, nursing students and house surgeons with 20 students from each group was conducted. It was conducted from 2016 July to 2016 September for a period of 2 months in Amala institute of medical sciences, a tertiary care hospital in Kerala.

Inclusion criteria

The study included all final year students in lab technician, nursing courses and house surgeons who gave consent.

Exclusion criteria

The study excluded staff nurses and lab technicians and consultant doctors to avoid experience bias. Final year MBBS students were avoided since they have no experience in collection of blood and urine unlike house surgeons.

Sample size calculation: A pilot study was conducted and sample size was calculated:

$$N = \frac{(Z_{1-\alpha} Pq)}{D^2}$$

$$\alpha = 0.05, 1.96$$

$$p = Q4: \text{Tourniquet time length allowed (66.6\%)}$$

$$q = 1 - p$$

$$D = \text{Relative precision (20\% of p)}$$

To avoid the experience bias the final year students in each group (lab technician, nursing and house surgeons) was included.

Only final year students who had exposure to ward blood collection or central lab sample collection were included in the study.

A pre-tested, self-administered and validated questionnaire was used to assess knowledge, attitude and practices in routine blood and urine collection with total 27 questions.

The questionnaire was sent to 7 experts for face validation and 8 subject experts for content validation; the questionnaire was also tested for reliability in a pilot study.

The questionnaire was administered to participants in each group on a pre-determined day. Out of 27 questions, 17 questions assessed knowledge of which 16 questions were framed as multiple choice questions (MCQ) and 1 question had match the following. 5 questions assessed attitude and was based on Likert 5 point scale. 5 question assessed practices with yes/no or sometimes as options. Written consent was taken from the participants before the start of study. The data was entered in excel sheets and analysed using appropriate tools. In depth interviews were conducted with subject experts to identify the most important and must know areas in the KAP questionnaire. 1 mark for each correct answer and 0 for wrong answers were given to 17 questions assessing knowledge. For each question assessing attitude scores ranging from 0 to 5 were given based on whether they strongly agreed/agreed/neutral/disagreed/strongly disagreed. Each practice question was given 0, 1 or 2 according to the response. The mean value of each group was found by dividing the score obtained by each student in terms of knowledge, attitude and practices by the total number of students in each group. The data collected was entered in Microsoft excel and analysis was done by SPSS software version 21. Appropriate statistical methods like ANOVA, t test were used.

RESULTS

In our study it was interesting to find that there was no statistically significant difference with respect to attitude among all the three groups (Table 1). 75% participants from each group strongly agreed that people involved in healthcare should know about routine blood collection and majority from all the three study groups agreed that improper sample collection can adversely affect the lab results.

Table 1: Comparison of knowledge among nursing students, house surgeons and Laboratory technician students.

Group	Number	Mean	Standard deviation	P value
Nursing	20	8.368	2.0058	0.0001
House surgeons	20	8.900	2.0749	
Lab technician	20	12.800	2.2384	

In our study there was statistically significant difference ($p < 0.0001$) was seen in practices of routine blood and urine collection (Table 1) though only 15% of house surgeons and 10% of nursing students gave response as being practicing blood collections when compared to higher percentages of technician course students (55%).

Table 2: Comparison of attitude among nursing students, house surgeons and laboratory technician students.

Group	Number	Mean	Standard deviation	P value
Nursing	20	21.58	1.4650	0.96
House surgeons	20	21.55	1.6376	
Lab technician	20	21.50	1.9600	

None of the participants in any of the groups had collected blood from infants during their ward postings or central lab postings. Overall in our study, technician students seemed to have higher percentage of actually practicing routine sample collection when compared to other two groups.

Table 3: Comparison of practices among nursing students, house surgeons and laboratory technician students.

Group	Number	Mean	Standard deviation	P value
Nursing	20	3.58	1.346	0.0001
House surgeons	20	4.75	1.517	
Lab technician	20	5.32	1.057	

DISCUSSION

Phlebotomy is a complex procedure that requires theoretical knowledge and manual skills, as well as accuracy, responsibility. The responses in KAP questionnaire showed that there was statistically significant ($p < 0.0001$) difference in the level of knowledge among house surgeons, nursing students, and lab technician students (Table 1) with less knowledge being among house surgeons. Among knowledge it is interesting to note here that though house surgeons knew what a tourniquet is there was comparatively less knowledge amongst them regarding the time a tourniquet could be tied. This information was known by nursing students and laboratory technician students (DMLT) better (Table 1).

Most alarming finding was that majority of House surgeons did not have knowledge on the effect of prolonged tourniquet on blood estimation values and its effects on many serum analytes like potassium, calcium, glucose etc. These reported values of serum analytes play a crucial role in decision making by the clinician, and therefore the clinician should be aware of possible pre-analytical errors in the collection, storage, and reporting of blood parameters. If tourniquet tying is prolonged it induces venous stasis and promotes the outflow of water, diffusible ions and low molecular weight substances from

the vessel, thus increasing the concentration of various blood analytes at the punctured site and potentially influencing interpretation of laboratory test results.¹⁶ House surgeons also showed less knowledge on the effect of fist clenching on calcium and potassium levels. Fist clenching is not recommended as it causes local release of potassium from the forearm muscle and increases blood flow and increased calcium.¹⁷

A similar study done in 2018 by Cai et al on nurses in China to assess their knowledge showed that there was inadequacy of knowledge on pre-analytical errors related to blood collection. They strongly recommended educational program to improve the knowledge.¹⁸

Wallin et al compared only nursing staff in wards and Laboratory technicians to check the adequacy of knowledge on blood sample collection and patient identification using questionnaire on pre-analytical practices in the hospital and they reported that laboratory technicians had more knowledge in blood collection techniques than nursing staff in the hospital wards.¹²

However, there is no study showing current knowledge in blood collection among medical students (house surgeons). In terms of attitude there was not much difference among the 3 groups. Lab results play pivotal role in healthcare and 60-70% of clinical decisions are based on laboratory results.¹⁹

The knowledge comparisons among the three study groups on urine sample collection and application showed a statistically significant difference ($p < 0.0001$) with DMLT/Laboratory technician course students having more knowledge and nursing students having lesser knowledge. This result emphasizes the need to consider these weak areas while training all the 3 courses and give equal weightage to the knowledge and assess it at regular intervals.

One of the reasons for this could be the syllabus of BSc nursing and technician courses in the affiliated universities which have mandatorily involved phlebotomy postings and lectures on routine sample collection, storage and transport.^{20,21} Though MCI has mentioned in its GME regulations routine sample collection, storage and transport as one of the competencies to be developed by Indian Medical Graduate (IMG) no dedicated teaching or demonstrations for the same is being practiced.²² This explains the reason for the lack of knowledge among house surgeons in the present study on routine blood collection techniques.

On comparing the house surgeons with the paramedical group it was found that there was a significant difference in knowledge among the two groups with house surgeons lagging behind in terms of knowledge. Even though the house surgeons have the attitude and inclination to practice proper blood collection, they did not involve themselves in practicing routine blood and urine sample

collection due to lack of sufficient knowledge regarding these. There are many studies done on pre-analytical errors and studies assessing KAP among nursing staff, nursing students, laboratory staff and laboratory students. But no study has been done so far on house surgeons. In 2016, Osegbe et al did a study on clinicians in a Nigerian hospital to assess their knowledge and post assessment of this data, they conducted training and followed it up for 6 weeks to see the rate of reduction in pre-analytical errors and could find lower rates of lab errors.²³ Their study too emphasizes the role of physicians in the reduction of pre-analytical errors. Based on our study, we insist that rather than training or educating the clinicians after the completion of MBBS course there should be a training module designed to acquire a mandatory skill by the end of the course.

If it was a multi-centric or multi -university study, could have been better to throw more light on the differences among the subgroups than restricting to a single medical college. Further studies on this topic, across many universities would enlighten us more.

CONCLUSION

Our study is first of its kind in comparing the knowledge, attitude and practices of final year nursing students and lab technician students with house surgeons. Through this study we could find out that there is a gap in the curriculum designing for MBBS. The 2017 MCI regulation on graduate medical education expects MBBS students to learn about blood investigations like hemogram. But it doesn't include a dedicated teaching module and does not emphasize the role of physicians in it.

Our study brings to light a gap in knowledge on blood collection practices. A dedicated training module should be included in the MBBS curriculum, so that when MBBS students become house surgeons they practice the techniques with confidence.

Recommendations

We would like to put forth a suggestion to MCI to include a pre-analytical training module to the MBBS students in their curriculum and sensitize them regarding the role of physician in reduction of these pre-analytical errors.

We would also like to recommend that more rigorous training modules be implemented to nursing and laboratory technician courses on reductions in pre-analytical errors, apart from continued technician and nursing training after they graduate and start working actively in health care sector.

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ANNEXURE

Questionnaire on Routine blood and urine sample collection

Instructions: Kindly spend max. 15 minutes to complete the questionnaire. Kindly tick appropriate options given as a,b,c,d to the questions asked. Any doubt kindly do not hesitate to clarify.

1: Most preferred adult venous blood collecting site is

- a) Median Cubital vein (vein in crook of the elbow)
- b) Popliteal vein (vein in the knee)
- c) Great saphaneous vein (Vein at the ankle)
- d) Dorsal venous arch (Veins of the dorsum of the hand)

2. Can the blood be collected from an inpatient setting from intravenous lines?

- 1) Collecting blood from arterial or intravenous lines is contraindicated
- 2) If no choice of other venous collection then shut off the fluid infusion 3 minutes before collection
- 3) Discard initial 10 ml of blood aspirated
- 4) Obtain the sample from opposite arm or below the site of infusion preferably
 - a) 1,2,3
 - b) 4,1,3
 - c) 3,4,1
 - d) 4,2,3

3: Tourniquet is

- a) Constrictive band for venipuncture and intravenous injections
- b) A needle used for venipuncture
- c) A constructive cuff to measure blood pressure
- d) None of the above

4. Tourniquet time length allowed

- a) 1 min b) 2 min c) 3 min d) 4 min

5. Prolonged tourniquet can affect which of the following estimations?

- a) glucose, calcium, sodium,
- b) calcium, potassium, bilirubin,
- c) calcium, potassium, LDH,
- d) glucose, calcium, potassium

6. Tight clenching of fist is not advisable during sample collection for analysis of ?

- 1) Potassium
 - 2) sodium
 - 3) Phosphate
 - 4) glucose
 - 5) lactate
 - 6) calcium
- a) 1,2,3,4
 - b) 1,3,5,6
 - c) 2,3,4,6
 - d) 2,3,5,6

7: What is order of draw for multiple specimen collection?

- 1) Sterile media for blood culture-yellow stopper colour
- 2) EDTA-Lavender, pearl white, pink-stopper colour
- 3) Serum separator- Gold/Red tube-stopper colour
- 4) No additive-royal blue stopper colour
 - a) 4>2>3>1
 - b) 2>1>4>3
 - c) 3>4>1>2
 - d) 1>4>3>2

8. The number of times the sample tubes without additives need to be inverted?

- a) 3-4
- b) 8
- c) 0
- d) 5

9. The number of times the sample tubes with additives need to be inverted?

- a) 3-4
- b) 8
- c) 0
- d) 5

10. The number of times the Serum separator/gold or red stoppered tubes need to be inverted?

- a) 3-4
- b) 8
- c) 0
- d) 5

11. What are the consequences of vigorous mixing of blood collected tubes over inversion

- a) Preferred in serum separator tubes
- b) Not to be done due to risk hemolysis
- c) Cuts short the 5 inversions to 2 vigorous mixing
- d) No difference between Vigorous mixing and inversion

12. Appropriate sample volume is important because

- a) Additive in tube is present in calculated proportion to blood to be collected
- b) Insufficient sample will lead to sample rejection during analysis
- c) Special add on requests can be performed if requested by patient
- d) All of the above.

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- b) Insufficient sample will lead to sample rejection during analysis
- c) Special add on requests can be performed if requested by patient
- d) All of the above.

13. The preferred site of blood collection in children > 1 year

- 1) Heel or big toe
- 2) Tip of finger
- 3) Ear lobe
- 4) Tip of nose
- 5) Venous puncture of cubital veins
 - a) Only 1
 - b) 1,2,3,4
 - c) 1,2,3,5
 - d) All of the above

14. Site of blood collection in infant (<1 yr old)

- a) Medial and lateral sides of heel
- b) Central part of heel
- c) Big toe
- d) None of the above

15. Most preferred site for arterial blood collection

- a) Radial artery
- b) Brachial artery
- c) Femoral artery in groin
- d) Dorsalis pedis artery on dorsum of foot

16. Hemolysed samples has notable effects on the estimation of :

- 1) Potassium
- 2) Lactate dehydrogenase (LD)
- 3) Magnesium and Phosphate
- 4) Aspartate transaminase (AST)
- 5) Glucose
- 6) Calcium
 - a) 1,2,3,4
 - b) 2,3,4,5
 - c) 3,4,5,6
 - d) 1,3,5,6

17. Match the following

- 1) First 10 ml of urine
- 2) Mid-stream urine
- 3) Double voided specimen
- 4) Random urine
- 5) 24-hr urine

- a) glucose excretion in OGTT
- b) bacterial examination of urethritis
- c) bladder disorders
- d) Any chemical tests at that moment
- e) Creatinine estimation, specific gravity etc.
- f) Kidney disorders
- g) 24-hr urine

Instructions: Kindly tick against the appropriate option given below

- 1) 5- Strongly agree
- 2) 4- Agree
- 3) 3-Neutral
- 4) 2-Disagree
- 5) 1-Strongly Disagree

Questions

Questions	5	4	3	2	1
1.The healthcare professionals should know about routine blood and urine collection techniques?					
2. You think you had sufficient knowledge in routine blood and urine collection					
3.Improper sample collection can affect the lab result values of the patient adversely					
4.There is need to be taught on the blood and urine collection techniques					
5.I will go back and learn more on routine blood and urine collection techniques					

Instructions: tick against the appropriate response

1. Have you regularly collected blood sample ever?
 - a) Yes b) No c) Sometimes
2. Have you regularly collected arterial blood under supervision
 - a) Yes b) No c) Sometimes (if No stop at this point)
3. Have you always left tourniquet tied for long while collecting blood samples?
 - a) Yes b) No c) Sometimes
4. Do you always follow the order of draw while collecting the blood samples?
 - a) Yes b) No c) Sometimes
5. Have you regularly collected blood samples from infant?
 - a) Yes b) No c) Sometimes