Study on "Assessment of Knowledge and Skills on PRE-ANALYTICAL VARIABLES Influencing Laboratory Testing" Among Laboratory Technicians and Nurses

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Abstract

Aim of the study: The aim and objective of the present study was to assess the theoretical knowledge and skills among the nurses and laboratory technicians about the pre-analytical variables involved in the laboratory testing using questionnaire and to assess the difference in knowledge and skills among these staff before and after training sessions using questionnaire. **Materials and Methods:** A prospective Study was conducted at Central Laboratory, Chandulal Chandrakar Medical College, Kachandur, Durg. The study involved a total of 54 participants, technicians and nursing staff. MCQ based questionnaire was given to all the participants to assess the knowledge and skills. **Results:** We included a total of 54 participants in the study which included both nursing staff and laboratory technicians, in which 34 were females and 20 were males with the mean age group of 20-60 years. The mean scores were calculated in all the participants based on the age and experience. Age of the participants did not make any difference in the score, however the mean score was proportional to the number of years of experience of the participants. Total participants were further divided into Technicians and Nursing staff. Out of 54 participants 26 were technicians and 28 were nursing staff. The mean score among the technicians was 5.8 ± 1.5 before training and was 8.7 ± 1.03 after training. The

mean score among nursing staff was 4.1 ± 1.9 before training and was 7.9 ± 0.8. Observational rate of knowledge and skills of nursing staff and laboratory technicians were classified based on their score. If the score is <50% as poor, 50-75% as average and >75% as good. The data showed that 42.4 % participants had poor score, 48.1 % had average score and only 9.25% had good knowledge. After the training the data showed 20.3% participants had average score, 79.6% had good score and none had poor score. **Conclusion:** Central laboratory is the backbone of the Hospital and technicians and nurses are the front-line in laboratory medicine. They play a pivotal role in the central laboratory. Most of these staff lack knowledge and skills with respect to laboratory practices, especially in the area of sample collection, pre-analytical variables and total testing errors. Since pre-analytical errors contribute to the maximum proven errors in the laboratory, this phase of testing must be strengthened in the laboratory testing. To improve and facilitate pre-analytical phase, as error free, the staff (technicians and nurses) should be constantly motivated and trained.

Keywords: pre-analytical variables, knowledge, skills, score & sample collection

1. INTRODUCTION

Central Clinical Laboratory is the backbone to the hospital set up, as it contributes significantly in making the right diagnosis to the right patient at right time and hence the right treatment, which affects the duration of hospital stay, early treatment response and the well-being of the patient. Modern day medicine practice is purely evidence based which focuses on the valid laboratory reports for the effective and timely management of patients [1].

The total testing process (or total testing cycle) in the clinical laboratory, is based on the original brain-to-brain loop concept described by Lundberg. He outlined a series of activities, starting with the clinical question in the clinician's mind, leading to test selection, sample collection, transport to the laboratory, analysis, reporting back to the clinician, and final interpretation and decision making by the clinician. All these activities have traditionally been separated into three phases pre-analytical, analytical and post-analytical. Reliable and timely test reports are the primary responsibility of the laboratory. Therefore, the total testing **process** must be managed properly in the pre-analytical, analytical, and post-analytical phases. The pre-analytical stage encompasses all the procedures which are take place before the analysis of the patients samples on the analyzers (e.g. blood drawing, sample transportation, centrifugation, dilutions etc) [2].

Laboratory errors might occur at any of these three phases, depending upon their source and time of presentation respectively. The pre-and post-analytical phases of the process account for 93% of the errors [3].

However, recent studies have shown that up to 70% of the errors are related to preanalytical phase of laboratory testing. The most common pre-analytical errors

include inappropriateness of test order, patient identification error, timing errors in sampling and preparation, hemolytic samples, lipemic samples, inappropriate transport and inappropriate sample collection tubes **[4].**

In the healthcare system, venous blood collection is one of the most commonly performed invasive procedure. Even though it is thought to be safe procedure, it is associated with its own risks. To perform phlebotomy successfully, a theoretical knowledge as well as practical skills are required. Lack of knowledge or skills may lead to errors in the procedure which might make patient suffer from injuries. Errors occur as the lab personnel do not always follow guidelines or not updated with the recent advances in the technique. It is very important to collect biological samples correctly to ensure accurate results. So, it is very essential to train the laboratory personnel who are involved in sample collection and handling **[5].** Good awareness about the importance of the knowledge and skills required for the new role of Technicians can improve the role of laboratories **[6].** A few studies are available which measured quality of venous blood sampling and knowledge of phlebotomies in carrying out the procedure. However, a few such studies are available in Indian settings, to the best of our knowledge **[7-9].** Therefore, we planned this study to assess the knowledge on pre-analytical variables using questionnaire to the nursing staff and laboratory technical staff and we compared the knowledge of these staff before and after training.

2. AIM AND OBJECTIVES

The aim and objectives of the study include,

a. To assess the theoretical knowledge and skills among the nurses and laboratory technicians about s the pre-analytical variables involved in the laboratory testing using questionnaire.

b. To assess the difference in knowledge and skills among these staff before and after training sessions using questionnaire.

3. MATERIALS AND METHODS

Source of Data: A Questionnaire Study was conducted at Chandulal Chandrakar Memorial Medical College, Kachandur, Durg Central laboratory. Informed consent was taken from all the participants included in the study. A total number of 57 nursing staff and laboratory technicians were included in the study. Nursing staff had a qualification of BSC nursing and General Nursing and the technicians had a qualification of DMLT. **Inclusion Criteria:** In our study, we included both technicians and nursing staff, since both the staff were associated with sample collection, patient preparation and sample transportation. Patient preparation and Sample collection of OPD samples were performed by Technicians and Patient preparation, Sample collection and Sample transportation of IPD samples were performed by Nurses. **Study Protocol:** All the study participants were given 10 MCQs to assess the knowledge and skills. Time given for each question was 45 seconds. These MCQ questionnaire consisted of the questions

which focused pre-analytical variables like Patient Preparation (fasting and post-prandial), Sample collection, Color coded tubes used for sample collection, Various anticoagulants used in various analysis, Dietary influence on certain parameters, Normal ranges of certain parameters. We had conducted several training classes weekly thrice various crucial topics like patient preparation, sample collection, order of draw, sample transportation, critical values, biomedical waste management, interfering factors in various biochemical assays, anticoagulants, arterial blood gas analysis, urine preservatives and syringe collection versus vacuum tube collection. After the training classes, again the knowledge and skills were assessed by questionnaire on these topics. **Statistical Analysis:** All the data collected was entered and analyzed using SPSS 16 software. Student Unpaired t test was used to compare the performance of the staff before and after training. Descriptive statistics was used to calculate the percentage of correct answers.

4. RESULTS

We included a total of 54 participants in the study which included both nursing staff and laboratory technicians. Out of 54 participants 34 were females and 20 were males with the mean age group of 28.1 ± 6.96 (range of 20-60) years. The participants (nurses and technicians) were divided into group A and group B according to the age. Group A (age less than 25 years) and Group B (age more than 25 years). 37% of the participants were aged less than or equal to 25 years and 62.9 % of the participants were aged more than 25 years. The participants were divided as per number of years of experience as less than 5 years and more than 5 years. The mean working experience of the staff was 4.9 ± 7.5 (range of 0.6 to 15 years), 61% of the participants had an experience ranging from 0-4 years, and 39% of the participants had an experience ranging from 5-15 years (Table 1).

Table 1: Comparison of scores in participants in Based on Age and Number of Years of Experience		
Based on Age	**≤ 25 years**	**> 25 years**
Total Number of Participants	20	34
Total score (out of 10)	4.2 ± 1.9	5 ± 1.8
Based on Number of Years of Experience	**≤ 5 years**	**> 5 years**
Total Number of Participants	44	10
Total score (out of 10)	4.49 ± 1.64	6.3 ± 1.33

Total participants were further divided into Technicians and Nursing staff. Out of 54 participants 26 were technicians and 28 were nursing staff. The mean score among the technicians was 5.8 ± 1.5 before training and was 8.7 ± 1.03 after training. The mean score among nursing staff was 4.1 ± 1.9 before training and was 7.9 ± 0.8. The mean

scores were compared between technicians and nursing staff before and after the training (Table 2).

Table 2: Comparison of scores in different groups based on number of years of experience		
	Technicians (n = 26)	**Nursing Staff (n= 28)**
Before Training	5.8 ± 1.5	4.1 ± 1.9
After training	8.7 ± 1.03	7.9 ± 0.8

Observational rate of knowledge and skills of nursing staff and laboratory technicians were classified based on their score. They were categorized as follows, which is represented in (Table 3).

Table 3: Shows Scoring Criteria for Knowledge and Skills	
Category	**Score**
Poor	<50%
Average	50-75%
Good	>75%

The data showed that 42.4 % participants had poor score, 48.1 % had average score and only 9.25% had good knowledge. Training classes were conducted to all the staff on weekly basis, that is 3 days a week, on each day two sessions were held for 45 minutes. They were are trained in pre-analytical variables and their influence on laboratory testing and the consequences due to errors. After the training, all the participants were again assessed for knowledge and skills by conducting written MCQ test. After the training the data showed 20.3% participants had average score, 79.6% had good score and none had poor score (Table 4).

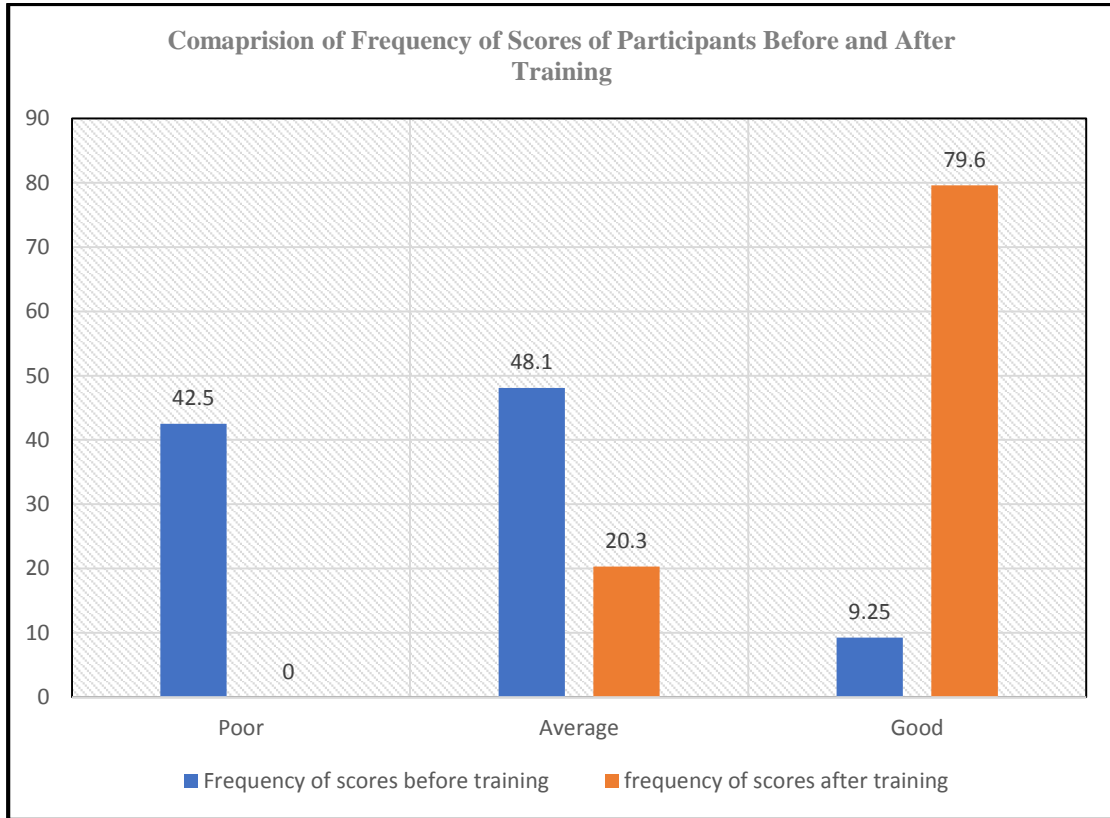| Table 4: Comparison of frequency of scoring before and after training		
Category/Score	**Frequency of participants before training (%)**	**Frequency of participants after training (%)**
Poor (**<50%**)	42.5	0
Average (**50-75%**)	48.1	20.3
Good (**>75%**)	9.25	79.6

Figure 1: Shows the comparison of frequency of scores of participants before and after training

5. DISCUSSION

Knowledge and skills focus on a certain topic are unique to a setting and are designed for a specific area. The knowledge possessed by them refers to their understanding of the topic. "Until the mind knows the eyes cannot see" same concept holds good in the laboratory set up, until and unless, the technicians and nurses are aware of the facts with respect to sample collection and the pre-analytical variables, it is practically highly challenging to assure the valid reports to patients, and build a confidence and quality assurance of the laboratories. Hence it is very important in the health sector to have competent and knowledgeable staff for the successful patient care.

In our study, we assessed all the participants (technicians and nursing staff) based on MCQ questionnaire, the questionnaire was focused on These MCQ questionnaire consisted of the questions which focused pre-analytical variables like Patient Preparation, Sample collection, Color coded tubes used for sample collection, Various anticoagulants used in various analysis, Dietary influence on certain parameters, Normal ranges of certain parameters.

In our study, we observed that there was no significant difference in the total score (knowledge and skills) between the two groups based on the age. However, we

observed that 42.5% of the participants had poor knowledge and skills, which is similar to the studies conducted by Milutinovic et al **[10]** and Dorotic et al **[11].**

The participants were divided based on the number of years of experience into, participants with experience less than 5 years and participants with experience more than or equal to 5 years. Among these participants, we observed that the mean score was increased in the participants having experience more than 5 years compared to the participants having experience less than 5 years. This finding is similar to the studies conducted by Zinder O**[12].**

Further, the total participants were divided into two groups as, Technicians and Nurses. The mean score was higher in technicians compared to nursing staff in our study. The reason may be that the technicians as part of their syllabus learn more about sample collection, sample preparation, sample processing and sample transportation. We had conducted several training classes weekly thrice various crucial topics like patient preparation, sample collection, order of draw, sample transportation, critical values, biomedical waste management, interfering factors in various biochemical assays, anticoagulants, arterial blood gas analysis, urine preservatives and syringe collection versus vacuum tube collection. After the training classes, again the knowledge and skills were assessed by questionnaire on these topics. After the training sessions, once again, we conducted the MCQ questionnaire test to all the participants to assess the improvement in knowledge and skills. However, we observed that the mean score was significantly higher in all the participants before and after training. Hence proper training of the laboratory technicians along with nursing staff in order to improve laboratory practices is highly recommended previously in the study conducted by Ezenwaka CE **[13].**

In our study, we used the scoring criteria as those who scored <50% were considered as poor score, 50-75% as average score and >75% as good score. According we assessed the frequency of scores of the participants, we found that 42.5% had poor score, 48.1% had average score and 9.25% had good score. We also assessed the frequency of the scores of the participants after training. After the training, we found that none of them had poor score, 20.3% of them had average score and 79.6% of them had good score. This is a clear-cut evidence that, all the institutes should provide effective training program to maximize the retention of the knowledge and skills of technicians and nursing staff about sample collection and pre-analytical variables and total laboratory testing in laboratory. Short term courses, training lectures, CMEs, Journal Clubs, Short Seminar Presentations, laboratory research, and updated information sessions about importance and use in error detection during laboratory procedures should be offered especially to technicians during their DMLT and BSCMLT period. Nurses should be offered clinical laboratory postings during their study period as a part of curriculum. Technicians should be frequently involved in updating their knowledge in automation, recent advances, new-challenges & various technologies. In order to, achieve advanced knowledge, they should read research papers, journals, company literatures of various parameters and articles published in various scientific papers and attend the refresher courses to develop commitment and dedication in their attitudes.

6. CONCLUSION

Central laboratory is the backbone of the Hospital and technicians and nurses are the front-line in laboratory medicine. They play a pivotal role in the central laboratory. Most of these staff lack knowledge and skills with respect to laboratory practices, especially in the area of sample collection, pre-analytical variables and total testing errors. Since pre-analytical errors contribute to the maximum proven errors in the laboratory, this phase of testing must be strengthened in the laboratory testing. To improve and facilitate pre-analytical phase, as error free, the staff (technicians and nurses) should be constantly motivated and trained.

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