

Pre-analytical Quality Assurance; An Important Milestone to be Achieved

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ABSTRACT

Objective: To assess the knowledge of junior doctors and nurses about proper collection, storage and dispatch of pathology specimens to the laboratory.

Methodology: This was a cross sectional questionnaire-based study conducted at Dr. Akbar Niazi Teaching Hospital (DANTH), Islamabad and Pakistan Ordnance factories (POF) Hospital Wah from Jan-June 2023. Hard copy of questionnaire with 29 questions regarding sample collection related to Hematology, Microbiology, Chemical pathology and Histopathology was given to junior doctors and nurses. Total 171 responses were received from junior doctors and nurses of both hospitals. Hundred participants were from DANTH and 71 from POF hospital.

Results: Fifty-eight nurses (34%) and one hundred thirteen doctors (66%) – mainly house officers and postgraduate trainees filled the questionnaire. Data was analyzed with SPSS 21.0 to calculate the percentages of correct answers. Overall, the knowledge was poor with mean score of 9.8 (35%) ranging from 5-17 for doctors and 5-14 for nurses. There was statistically no significant difference ($V=12.134$, $df=12$, $p=0.435$) in the knowledge of doctors ($\bar{X}=9.98 \pm 2.4$) and nurses ($\bar{X}=9.5 \pm 2.3$). However, in Clinical Chemistry and Histopathology doctors had slightly better knowledge than nurses.

Conclusion: This study showed lack of knowledge in nurses and junior doctors regarding proper sampling. It seems appropriate that medical students and paramedics should get an awareness about sample collection as part of their curriculum to avoid extra workload on the laboratory as well as proper management of patients.

Keywords: Preanalytical error, automation, coagulation testing, sample identification errors.

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Introduction

Diagnosis and treatment of patients depends on accurate laboratory results. Precise Laboratory assessment plays a key role in decisions regarding diagnosis and treatment of 60 to 70% of patients.¹

It was found in the decade of 1970s that even by observing high quality standards during analysis in laboratories many pre analytical variables had a remarkable influence on the

test results.² Sample collection in the laboratory mostly involves drawing blood through venous puncture and putting them in tubes. Defective sampling has a marked influence on the accuracy of results for example under filling of blood collection tubes leads to higher Lactate dehydrogenase (LD) and Potassium levels.³ Similarly in microbiology for instance blood cultures can get contaminated if proper antisepsis is not done before venepuncture.⁴ Similar is the case with histopathology

specimens. The collection of tissues involve invasive procedures and cannot be repeated again. Their proper collection and preservation is important to ensure proper diagnosis and further management of the patient.⁵

Specimen collection in hospitals in inpatient setting is routinely done by nurses or junior doctors instead of phlebotomists and standardized protocol concerning sample collection is not followed most of the time, therefore majority of errors take place in the pre analytical phase.⁶ In view of the marked improvement along with automation in the analysis, erroneous lab results account for 7-13% occurring in the analytical phase.⁷ compared to about 46- 68% of total inaccuracies in the pre analytical phase leading to the conclusion that appropriate collection of specimens and their preservation is an essential and critical step mandatory in the reporting of good quality results. Proper awareness among healthcare workers regarding collection and storage can be very helpful, based on which precise diagnosis and good treatment objectives can be achieved.⁸

This questionnaire-based study was conducted to assess the knowledge of junior doctors and nurses about proper collection, storage, and dispatch of pathology specimens to the laboratory. These include samples requiring analyses for histopathology, clinical chemistry, microbiology, and hematology.

Methodology

It was a cross sectional questionnaire-based study conducted after approval of the ethical review board of Islamabad Medical and Dental College from Jan-June 2023. Study was conducted at two teaching hospitals of Rawalpindi & Islamabad equipped with 500-beds. Sample collection is mostly done by junior doctors and nurses in both hospital setups.

Sample size was calculated by using an online statistical calculator.⁹ Assuming that 29% of the subjects in the population have the factor of interest, the study would require a sample size of 162 for estimating the expected proportion with 7% absolute precision and 95% confidence.

Non-probability purposive sampling technique was used. Hard copy of questionnaire with 29 questions regarding sample collection related to Hematology, Microbiology, Chemical pathology, and Histopathology was given to 200 junior doctors and nurses assuming response rate of 85%. The questionnaire comprised of 16 questions regarding microbiology, 7 questions of Clinical Chemistry, 2

questions of Hematology and 4 questions related to Histopathology. Total 171 responses were received from junior doctors and nurses of both hospitals. Results of 100 participants were collected from Dr. Akbar Niazi Teaching Hospital (DANTH) Islamabad and 71 results were obtained from the setting of Pakistan ordinance factory (POF) hospital, Wah.

Results

Fifty-eight nurses (34%) and one hundred thirteen doctors (66%)- mainly house officers and postgraduate trainees filled the questionnaire. Data was analyzed with SPSS 21.0 to calculate the percentages of correct answers and find difference between knowledge levels of doctors and nurses. The questionnaire was divided in 4 sections namely Histopathology, Hematology, Clinical Chemistry and Microbiology with 4, 2, 7 and 16 questions respectively. For each section the score was categorized as either poor (<50%), average (50-80%) or good (>80%).

Overall, the knowledge was poor with mean score of 9.8 (35%) ranging from 5-17 for doctors and 5-14 for nurses. There was statistically no significant difference ($V=12.134$, $df=12$, $p=0.435$) in the knowledge of doctors ($\bar{X} = 9.98 \pm 2.4$) and nurses ($\bar{X} = 9.5 \pm 2.3$) as shown in Figure 1. However, in Clinical Chemistry and Histopathology doctors had better knowledge whereas nurses had better knowledge in Hematology. (Figure 2)

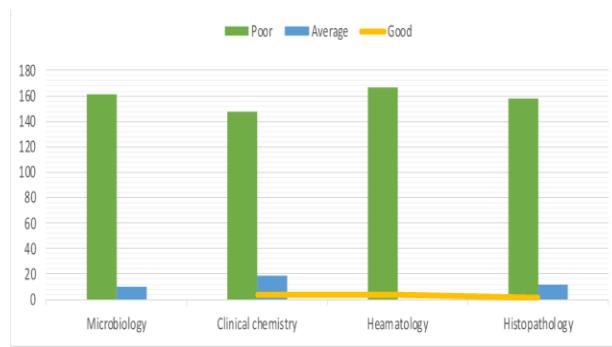


Figure 1: Frequency of well-informed and poorly informed participants regarding preanalytical error in all four categories.

Regarding questions on Histopathology, 104 (92%) doctors and 54 (93%) nurses had poor knowledge. Only 1 doctor had good knowledge in this category (Table I). Majority, 103 (60%) knew about minimum fixation time for a specimen in formalin whereas the knowledge was poor related to ideal fixative for a surgical specimen 23 (13.4%), volume of formalin required for sending histopathological specimen 62 (37%) and about number of

containers required for c/s, special stains & histopathology 37 (21.6%).

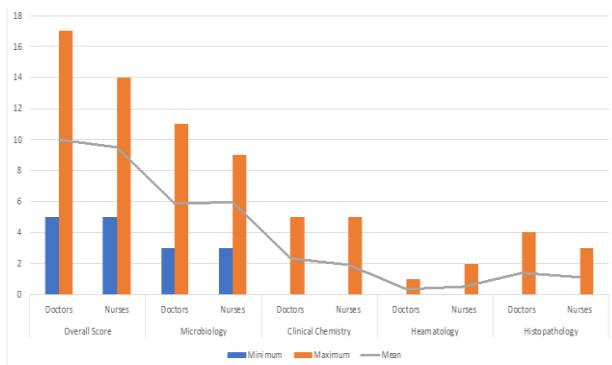


Figure 2. Comparison of overall & section-wise knowledge regarding pre-analytical errors between doctors and nurses.

In Hematology section good knowledge was observed in 4 nurses as compared to microbiology where no participant had awareness of specimen collection. Poor knowledge was observed in 113 (100%) doctors and 54 (93%) nurses (Table I). Only 53 (30%) knew about optimum time within which the coagulation profile of a blood sample should be checked and 15(9%) knew about EDTA induced platelet clumping.

In the Clinical Chemistry category, only 4 (2%) had good knowledge in this section (Table I). Out of total 171 participants, 94 (83%) doctors and 54(93%) nurses had poor knowledge. Out of total only 66 (38.5%) knew that the time for urine sampling to check proteins is early morning, 89 (52%) told the best way to submit urine sample for diagnosis of tuberculosis. Very few 23 (13.4%) could discern about collection of mid-stream urine. Well-informed on the protocol to collect CSF specimen were 68 (39.7%), 52 (30%) could correctly identify the result of prolonged tourniquet application.

In Microbiology category, 105 (93%) doctors and 56 (96%) nurses had poor knowledge. Nearly half of the total sample 80(46.6%) knew the details of taking blood culture whereas few i.e., 32 (18%) could tell the best time to take blood sample in bacteremia patient. Time required to stop antibiotics before taking blood culture was discerned by 72 (42%) and 89 (52%) recognized the correct time to take blood culture if antibiotics could not be stopped. Nearly 58 (34%) were aware of the procedure of taking throat swab and 65 (38%) had information about sending a specimen for c/s. Only 44(25%) were aware of the instructions to be given for sputum collection and 53 (30%) had knowledge about taking urine specimen for culture in a patient with catheter. Awareness of the right specimen for diagnosing gonorrhea in male patients was acknowledged by 52

(30%). More than half of the participants 93 (54.3%) correctly identified the specimen not suitable for ZN staining for Acid-fast bacilli and only 28 (16.3%) knew the right specimen for N. gonorrhoea culture in female patients. Identification of 70% alcohol as the right chemical to clean skin & nails before taking culture for fungal microscopy was done by 98 (57%). Best site to take scrapings for fungal culture was documented by 80 (46.7%) participants. Only 29 (16.9%) knew the correct procedure for sending specimen for fungal microscopy & culture, 42 (24.5%) reported the suitable sample for checking casts in urine, and 95 (55.5%) recognized the specimen never to be refrigerated.

Table I: Frequency of knowledgeable doctors and nurses regarding preanalytical errors.

| Occupation | Histopathology | | | P-value for chi-square |
|--------------------|----------------|-------------------|----------------|------------------------|
| | Poor knowledge | Average knowledge | Good Knowledge | |
| Doctors | 104 | 8 | 1 | 0.771 |
| Nurses | 54 | 4 | 0 | |
| Haematology | | | | |
| Doctors | 113 | 0 | 0 | 0.005 |
| Nurses | 54 | 0 | 4 | |
| Clinical Chemistry | | | | |
| Doctors | 94 | 16 | 3 | 0.186 |
| Nurses | 54 | 3 | 1 | |
| Microbiology | | | | |
| Doctors | 105 | 8 | 0 | 0.3380 |
| Nurses | 56 | 2 | 0 | |
| Overall score | | | | |
| Doctors | 9.98 ± 2.4 | | | 0.435 |
| Nurses | 9.5 ± 2.3 | | | |

Discussion

Sample collection in the pretesting phase is the most susceptible step that can eventually lead to misdiagnosis and mismanagement of the disease. Precise laboratory results influence 60-70% of the clinical decisions and help in determining the appropriate course of treatment and management of the patients.¹⁰ Multiple studies have been conducted to check awareness of specimen collection among health care staff for lab investigations worldwide.¹¹

In our study, knowledge of doctors did not differ statistically than the knowledge of nurses regarding specimen collection for various laboratory tests. In our study majority knew about minimum fixation time for a specimen in formalin and some had knowledge about volume of formalin required for sending histopathological specimen. In specimen collection for clinical chemistry significant number of participants knew the best way to

submit urine sample for diagnosis of renal tuberculosis in contrary to a survey conducted in India.¹² Doctors in our study were ahead of nurses in having knowledge regarding specimen collection of Histopathology, Clinical chemistry and Microbiology. Local studies also showed similar results.^{13,14} Knowledge of doctors was much better as compared to health care staff in a study done in England.¹⁵

We observed poor knowledge of specimen collection in Hematology among both doctors and nurses. Very few knew about the platelet antibodies responsible for the platelet clumping. Many studies^{10,16,17} reported that paramedical staff showed negligence and careless attitude during sample collection and transport. Similar attitude was observed in a retrospective study conducted in a tertiary care hospital.²¹ Studies have been conducted that showed 2-4 times reduction in pre analytical errors when the staff was properly trained.^{11, 19, 20}

In the assessment of knowledge for microbiological investigations it was found that both doctors and nurses did not have good knowledge about the time of collection and nature of the specimen required. Higher mean value was observed in the awareness of doctors as compared to nurses. This knowledge was also deficient in a similar study conducted in Turkey.²¹

Data regarding studies for awareness of sample collection in Pakistan is not enough. Lack of awareness was also observed in a local study done for screening for errors in sample collection for clinical chemistry analysis. They insisted on strictly implementing specific standard operating procedures precisely for specimen collection and transportation.²² In another study, sample clotting, hemolysis and inadequate sample volume were the major errors^{23, 24} and related with high or low workflow in the hospitals.

Precise sampling is also stressed upon by International Organization for Standardization (ISO), which states that laboratories should implement quality indicators to assess sample collection, analysis and reporting of lab results.²⁵

Most of the nurses did not know that saliva is not suitable for AFB staining, no wonder why many of the specimens are rejected due to being saliva rather than sputum. This is quite low as compared to a study done in India¹², this is probably due to the presence of free TB centers around the country due to which private hospitals receive very few such cases thus our nurse's exposure is very low but still being a high TB burden country our staff should have good knowledge about TB.

Very few percentages of nurses knew about the mid-stream urine, which is quite alarming as this is one of the most common test sent to a lab. Similarly, both the doctors and nurses did not know the effect of delayed transport of sample on the level of serum potassium.

Conclusion

This study showed lack of knowledge in nurses and junior doctors regarding proper sampling. It seems appropriate that medical students and paramedics should get an awareness about sample collection as part of their curriculum to avoid extra workload on the laboratory as well as proper management of patients.

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