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Errors That Must Be Avoided in The laboratory to Achieve Maximum Accuracy in The Medical Analysis.

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Abstract:

Background: Owing to increasing attention focused on patient safety and the need to decrease laboratory errors, it is necessary that clinical laboratories collect statistical data on error occurrence rates over the all testing cycle, involving pre-, intra-, and post-analytic phases.

Methods: This descriptive aims to evaluate the frequency of errors before, during, and after analysis in a major medical laboratory. There for we can determine the factors causing these errors to avoid them, improve the work strategy in clinical laboratories so obtain highly accurate medical reports, it analyses data from observational studies, surveys, and intervention trials.

Results:

The results show that the most laboratory errors induced during pre-analytical stage, the good training and knowledge of the intervening factors that can influence laboratory results are necessary to reduce laboratory errors. It is recommended that the three phases of laboratory tests need to be under thorough monitoring so that improve the accuracy and the quality of results.

Discussion:

The findings of the literature review show that despite heterogeneity in methods, the errors may occur through the different stages of testing process. Despite the

importance of pre-analytic stage has been known for many years, laboratories usually missed this point in their quality management program and focusing on the analytic quality and the activities associated within their direct control. We should know that it is unrealistic to decrease the laboratory testing errors totally especially those relating to extra-analytic stages which are difficult to control, The necessary of good laboratory practice and compliance with the new accreditation standards, that include good strategies to prevent the error as process redesign, the use of extra-analytic specifications and improve the communication between laboratory technicians. Finally, it is recommended that laboratories with high volume of work need to be equipped with HIS system. This will help the laboratory staff to be undercut and errors could be minimized.

Keywords: Different Phases of Testing, Errors, laboratory Medicine.

Introduction:

Medical laboratories have an important role in the healthcare system and help in decision-making of clinical doctors about the patients. 60–70% of clinical decisions about hospitalization and prescription are depending on laboratory reports. Clinical tests help in screening, treatment follow-up, and evaluate the patient response to treatment. So the quality of laboratory tests have significant role to conform the highest standards. Laboratory services must be accurate and quick to prove effective. The errors may occur during the process which consists of three stages the pre-analytic, analytic and post-analytic stage errors. Most errors occur before the test or during the sample collection, however handling the specimen and processing, physiological, and endogenous variables. All these factors affect on the laboratory results so we must differentiate between these changes and the disease-related changes.

This essay seeks to the important role of medical laboratories in disease diagnosis and how reduce the errors that may affect on the laboratory results causing miss diagnosis of the disease. The following are some of the paper's goals:

1. Studying the laboratory test cycle which consists of three stages the pre-analytic, analytic and post-analytic stage.
2. Studying the factors affecting on the laboratory results.
3. Determining the errors that must be avoided in the laboratory to achieve maximum accuracy in the medical analysis.
4. Proposing effective strategies for improving the work inside the lab.

Literature Review:

Decreasing errors and improving quality are an important part of Pathology and Laboratory Medicine as well as the rate of errors occurs during the three stages of the

analytic process of a specimen. The types and frequency of errors and quality systems are very critical for cytopathology, clinical chemistry, hematology, microbiology, molecular biology, and transfusion medicine. **(Hollensead et al., 2004)**

Misidentification of a patient or a sample considered one of the most important error factors that may occur during the pre-analytical stage mostly or during the whole test cycle which induce patients harm. In transfusion medicine patient identification errors occur in high rat around 1% for general laboratory samples. Technology, ranging from bar-coded sample labels to radio frequency identification tags, should be applied as protective systems which help in detecting and correcting the human error and decrease the incidence of misidentification of patients and specimens. **(Valenstein and Sirota 2004)**

Laboratory testing, considered a very complex process which called the total testing process (TTP), and consisting of three analytic phases (pre-, intra-, and post- analytic stage). Most of errors in this process occur during the pre-analytical phase, due to individual or systemically defects. To decrease the incidence of errors in TTP, the pre-analytic stage must be prioritized. Add to this developing procedures, providing good training, improvement of interdepartmental cooperation, information technology and robotics also can be an important factor to decrease errors during samples collection and pre-analytic handling of samples. **(Da Rin 2009)**

Most errors in laboratory medicine induced during the pre- and post-analytical stage. Although these errors are commonly occur in all laboratory medicine specialties, it is very important for the haematology laboratory to detect the particular impact of some an automated counting. Although the pre-analytical stage is the critical stage but pre-analytical errors may not detected until post-analytical validation and interpretation. The obstacles in the post-analytical stage including the standardization of reference intervals against which results can be interpreted and the impact of just a small difference in reference interval for a key analyte as in case of haemoglobin concentration. Quality indicators against which pre- and post-analytical error occurrence are important source of information that help in improving the services but laboratories struggle to obtain good quality data. **(Salle 2019)**

Laboratory errors represent 0.012 to 0.6% of all test results and have the main role of the laboratory in diagnosis, which cause large adverse effect on patient care. Laboratories play an important role in enhancing the patient safety through a variety of improvements as increasing the automation of manual processes and analytical quality control programs. It is necessary that all laboratories have good systems to identify and monitor quality failures. Quality failures can be classified according to the cause i.e., the step in which the problem occurred and the severity into 5 point scale. The severity grading score evaluate the Actual impact ['A' score] on patient outcome and the Potential impact ['P' score] i.e., the worst case perhaps occur that

may resulted. 'A' scores refer to low adverse patient impact while 'P' scores refer to high adverse impact. **(Maurice 2009)**

Evaluation Methods:

The laboratory testing process starts either as a requisition from the hospital or by doctors in private clinics. In case of patients in hospital , the laboratory record the patients' identification data including their name, age, sex, file number, and physician's name and register them in the hospital information system (HIS) and blood samples are collected and transported to the laboratory department. For outpatients, doctors in private practice wright the requisition Then, the laboratory record the patient's identification data into the laboratory information system (HIS). The laboratory staff collect the suitable samples from patients to analyze them. A laboratory technologist check the samples for misidentification errors, inappropriate container, improper labeling, inadequate collection of the sample, and inadequate ratio volume of sample/anticoagulant. Any noticed errors are recorded to the ordering department and request is sent for a new good sample. The samples are prepared for analytic procedures as centrifugation, aliquoting, and sorting specimens are performed and then different tests are done. After a quality manager who is a technologist or a laboratory physician monitoring and checking the samples the reports are sent to medical staff for evaluation, interpretation, and appropriate action. **(Abdollahi et al., 2014)**

Discussion:

Medical laboratory test results play important role in the decision-making by clinical doctors. Some studies recorded that about 70% of clinicians' decisions depend on laboratory results. So, the quality, accuracy, and precision of laboratory results are very important in clinical care.

In the discussion section, the findings from both the literature review and the evaluation methods recorded that the proportion of errors usually occur in pre- and post-analytical phases of testing at rate of 4–5 times higher than that occur in analytical phase with pre-analytical phase representing over half of the errors in published studies**(Lippi et al., 2006).** On the other hand another study, pre-analytical errors recorded 46–68.2% of total errors while a high error rate 18.5–47% of total errors has been found in post-analytical stage **(Hawkins 2012).**

Another study in an Italian stat laboratory was recorded once in 1996 and then in 2006 found that despite a 34% reduction in error rate, the pattern of 62% pre-analytical, 15% analytical, and 23% post-analytical stage errors remained unchanged. The results of the study recorded that about 65.09% of errors occur in pre-analytical stage while about 23.2% and 11.68% occur during analytical and post-analytical stages, respectively.**(Plebani 2006)**

In the discussion section, the findings from both the literature review and the evaluation methods are synthesized to identify key challenges and opportunities for enhancing hand hygiene compliance among healthcare workers **(Erasmus et al., 2010).**

This section emphasizes the necessity of multifaceted interventions, continuous monitoring, and ongoing education and training to promote sustained behavior change. According to different studies there are human factors including personal skills in venipuncture and laboratory tests carried out for the patients. The results also showed that errors in hospitalized patients were more various than in outpatients may due to the critical conditions of hospitalized patients and the variety of staff involved in the total testing processes. So the samples may be collected by nonexpert staffs. Add to this the methods by which the samples were transported to the lab and the appropriate transporting times for different laboratory tests considered important factors in reducing the incidence of errors. The samples must be transported to the lab in the shortest possible time. The vacutainers (glass or plastic tubes) should be protected from being broken by putting them in special vessels. **(Bonini et al., 2002; Carraro and Plebani 2007)**

Another study showed that errors for inpatients and outpatients did not differ in the analytical phase and were mainly because of the factors that could be prevented by an accurate and precise quality control procedure. In the analytical stage of this study, errors for inpatients and outpatients did not differ meaningfully and were mainly due to factors that could be prevented by an accurate and precise quality control procedure. In the post-analytical phase, the errors did not record wide difference between these two groups and they caused by human errors in reporting procedures. **(Karla 2004 and Lippi et al., 2006)**

On the other hand the comparison between some studies supposed that analytic errors more common due to the aging equipment's state-of-the-art technology not used any more or possible due to inadequate training of laboratory workers**.(Carraro and Plebani 2007; Da Rin 2009)**

The majority of errors recorded in the study related to the patient or the sample misidentification (Ristelli and Noble 2017), considered one of the most factor that annoy laboratory staff. This error may occur inside and outside the clinical laboratory, and strongly threaten the patient safety. In the United States, approximately 25 deaths per year are recorded due to a hemolytic transfusion resulting from misidentification errors [8]. It is necessary to focus on this error before release the results, laboratories already applied procedures and systems that compare the laboratory results with results obtained on previous samples from the same patient, “zero errors” difficult to be achievable. This may due to the difficulty to detect this type of error. **(Valenstein and Sirota 2004)**

Conclusion

Laboratory errors mostly are related to pre-analytic phase; so good training and knowledge of intervening factors are very essential for reducing the errors that may be occurred and optimizing the quality in labs. A correct pre-analytical stage procedure is very important to obtain an adequate sample and consequently achieve the most accurate laboratory results, promoting patient safety. Continuous changing of laboratory staff increase the need to establish improvement strategies to decrease the error risk. The custom label system decreases the forgetting to draw a tube, which happens usually when operating without appointments, by printing the labels according to requested tests. Other factors as detection, identification, and monitoring of the error and implementing strategies to improve preanalytical quality reduces errors and so improves patient safety and health system outcomes.

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