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Challenges Faced by Laboratory Technicians in Interpreting Blood Test Results in Patients with Blood Disorders: A Theoretical Study

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Abstract

Introduction: The accurate interpretation of various blood test results in patients with blood disorders determines the accuracy of diagnosis and the provision of quality care. The accuracy of the interpretation of blood test results is influenced by the level of expertise, continuing education, and the knowledge of the laboratory staff. The ability of the laboratory staff to interpret blood test results depends on the scientific theory and practical skills learned during college and scientific continuous training, so that the role of the laboratory or supporting staff becomes critical. This paper discusses the challenges faced by laboratory technicians in interpreting blood test results in patients with blood disorders. They also have a responsibility to understand and communicate the biological relevance of the pathology report to the treating clinicians, and to be accurate, they must harness and develop a unique combination of conceptual and experimental skills. However, the comprehension of a complex package of information about single and/or multiple conditions present in the same patient, and the medical history, can be very demanding.

Methods: This study employed a qualitative approach and was anchored within grounded theory research design. Developing grounded theory is based on the premise that data analysis is an inductive process. The approaches used for data collection were semi-structured interviews, a focus group discussion, and fieldwork notes. Data were collected using purposeful and theoretical sampling.

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Conclusion: This paper demonstrates the crucial role of laboratory technicians in interpreting blood disorder test results. The study reveals that technicians face difficulties in interpreting results, specifically quantitative, qualitative, and morphological aspects. Recognizing these problems is essential to minimize interpretation errors and improve patient safety. To address these challenges, new instruments and a structured approach are needed to assist technicians in result interpretation. This will enhance knowledge sharing and collaboration among professionals.

Keywords: Interpretation, Semi-structured, Demonstrates.

1. Introduction

Laboratory departments are critical for clinical diagnosis and management. This involves producing accurate results for test orders made by physicians. However, some are misinterpreted more often than others, like the results of hematology tests. Those with abnormal results, especially in conditions of severe anemia, leukemia, or the indication of lymphoproliferative neoplasms, trigger the greatest confusion. This study aimed to describe the challenges faced by health center laboratory technicians in interpreting blood test results among patients suspected of blood disorders.

In Mozambique, provincial laboratories are capable of performing few blood tests, and most patients with blood disorders are referred for blood testing to the Maputo Central Hospital or the Beira Central Hospital. However, due to the limited capacity of these hospitals, the results may take several weeks to finally be sent back to the provinces where the patients live. In some instances, due to transport difficulties, the results may not arrive at the health institutions where the patients conducted the test. This delay sometimes influences the laboratory technicians to take the responsibility to help patients with life insurance to interpret their results. Some laboratory technicians noted challenges and requested to attend training on hematology to facilitate this process. Furthermore, some clinical officers at both health institutions complain about laboratory results leading to the misdiagnosis of patients with hematologic disorders.

1.1. Background and Rationale

Medical laboratory personnel are a vital aspect of patient care and are responsible for conducting thousands of diagnostic tests on blood and body fluids. The majority of the population in South Sudan often visit medical laboratories for blood tests, and laboratory professionals interpret these tests. It is important for laboratory professionals to understand the tests and interpret the results accurately to provide valuable information to guide clinicians in making prompt and accurate diagnoses. The accuracy of the results is affected by how samples are collected and how patients with blood disorders are managed pre- and post-test, including management practices before samples are taken, the collection of

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anticoagulated venous samples, the care and storage of the sample before the analysis is performed, the analysis, and the correct interpretation. It is important that laboratory professionals understand the laboratory data generated from blood tests in order to interpret the true health status of the patient, as an accurate medical diagnosis depends on accurate analysis and interpretation of blood tests.

However, many laboratory professionals are poorly trained in the recognition and differentiation of hematological and oncological blood tests and are less confident in data based on manual methods than on measurements obtained from automated instruments. Laboratory professionals can only perform manual methods as a last resort when using automated methods that generate unacceptable results, supervision of quality, internal quality control materials, and documenting the reliability of manual results that are manually generated when specifically requested. Accurate evaluation of blood tests is important in monitoring the response of hematopoietic and oncological blood patients to treatment. Blood tests are requested in patients with blood disorders who require anesthesia and surgery to assess their overall health, so that the anesthesiologist is aware of any deformities, the explanation of blood electrolytes, and the effect on clotting time.

1.2. Research Aim and Objectives

Laboratory test results often appear in blood tests as part of the diagnostic process for patients with blood disorders. The results yielded from the blood tests are incredibly important and consequently need to be interpreted correctly in order to achieve the best possible medical care for the patients. The research emphasizes the perspective of laboratory technicians in interpreting blood test results for patients with blood disorders. Although similar issues are perceived by nurses, doctors, and patients, very little attention is paid to laboratory technicians. The predominant relevant issues in blood tests have been linked to problems throughout the pre- and post-phases of the patient care process. Some can be traced to patients, some to healthcare providers, and others to systems-related problems. In this research, the perspective of laboratory technicians allowed for a focus on simpler issues that can be more easily addressed by either patients themselves or through simple shifts in the orientation of healthcare providers. The most obvious shift involves the training, roles, and policies that guide laboratory technicians. No research directly considers the situation of laboratory technicians as frontline workers interpreting and helping to ensure the quality of blood test results prior to their release to healthcare providers. This research aims to conceptualize many of these challenges. It is a first step toward understanding the broader institutional, administrative, and service-related issues linked with the results phase of the patient care process from the perspective of laboratory technicians.

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2. Understanding Blood Disorders

Blood consists of plasma and the formed blood elements, which are conglomerates of cells and cell fragments suspended in the plasma, accounting for 55% and 45% of the total blood volume, respectively. Blood has three main functions that are vital to human survival, which include the transport of oxygen and nutrients to cells, the removal of carbon dioxide and waste products, and the suppression of hemorrhage. Blood-related diseases are diseases that alter the structure and function of its components and of the organs that generate them, resulting in various clinical manifestations and progressive life-threatening conditions. Blood functions are controlled by different components present in the blood, including erythrocytes or red blood cells, white blood cells or leukocytes, blood platelets or thrombocytes, clotting factors, plasma, and coagulation inhibitors. Deficiencies in the quantity or functionality of the blood components can result in hematological disturbances. Coagulation factors are proteins that are synthesized mainly in the liver and maintain hemostasis by promoting coagulation to prevent injury to the internal vasculature endothelium. Moreover, the inhibitors regulate clot formation, and their deficiencies or increased levels can result in either longevity or severity of occlusive thrombus formation. Blood disorders can be classified on the basis of the effect on different components, such as hematology, blood coagulation, and cell formation, life span, immune system module, and clotting module.

2.1. Types of Blood Disorders

Blood disorders include any disruption of normal blood flow in the body, including too low levels of red blood cells, too high levels of red blood cells, too many platelets in the blood, and too many or too few white blood cells. Laboratory examinations are one of the activities carried out to determine blood disorders. The results of laboratory tests on blood components can provide an overview of patient blood conditions so that they can be used as a fundamental assessment before performing further tests and treatments. However, laboratory examination results cannot be interpreted by the general population, especially for people who have not received the necessary information. The interpretation can only be understood by laboratory technicians, usually with the assistance of a specialist doctor. Blood diseases can affect many organs and systems in the body. A person's activity level can be greatly affected by the disease experienced, ranging from simple activities, levels of fatigue, and other disease symptoms.

In general, laboratory examinations and blood tests are done to determine the levels of red blood cells, white blood cells, and platelets in the blood. This examination can show various types of blood diseases such as leukemia, polycythemia, thrombocythemia, anemia, and others. The function of this examination is to find out the level of red blood cells, white blood cells, and platelets in the blood. This examination is done by taking blood from a vein and examining it under a microscope. The human body contains a large number of blood cells,

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including red blood cells, white blood cells, and platelets. Each blood cell has a different and important role in the human body. The red blood cell's main function is to transport oxygen from the lungs to the body tissue. The white blood cell is the main part of the immune system that fights against bacteria, viruses, and other types of germs. The platelets are essential in the blood clotting process when bleeding. These cells are produced in the bone marrow.

2.2. Diagnostic Tests for Blood Disorders

Cultural and laboratory technicians interpret blood test results of patients with blood disorders and their families. There are many diagnostic tests that can be conducted to diagnose blood disorders in patients. Diagnostic tests for blood disorders can be differentiated into hematologic, immunochemical, DNA, and cytogenetic-based tests. Hematologic tests can be conducted to obtain deoxyribonucleic acid, which is the nucleus of all blood cells. Hematologic tests for blood disorders are usually conducted to analyze normal cell structure abnormalities, size, and number of blood cells. There are two primary hematologic tests for blood disorders, including a complete blood count test and peripheral blood smear. The complete blood count test is conducted for various purposes related to diagnosing, monitoring, and controlling diseases. This test measures the number of red blood cells, including hemoglobin and hematocrit levels, the number of white blood cells, and blood platelets. The peripheral blood smear is the examination of a patient's blood cell content using a powerful microscope. This test is essential for the differential diagnosis of many diseases of the blood and bone marrow. The second test evaluates the size, shape, and amount of red blood cells, hematocrit, hemoglobin, white blood cells, and blood platelets, computed automatically and in more detail. Small, round, and normal-shaped red blood cells is a normal indication of the complete blood count test. Changes in red blood cell color and shape are observed in the different etiologies of hemolytic and macrocytic diseases. Furthermore, hematologic tests can be conducted to examine changes in white blood cell count in patients with malignant tumors and in the bone marrow.

3. Role of Laboratory Technicians

All laboratory tests are performed by trained laboratory technicians and supervised by more qualified medical technologists with a deep understanding of the normal physiology and biochemistry distinguishing a healthy person from a patient suffering from complications of different diseases. In light of the developed sciences in the field of diagnosis and technology in the laboratory, laboratory staff can add a perspective that supports the doctors in charge of managing the patients. The available database for lab reports cannot determine the reliability of these reports without having a scientific and professional basis on human health, how the laboratory report was extracted, and the methods and materials that were used to extract this report, in addition to knowledge of the units of results of various laboratory tests due to the difference between different tools of measuring and extraction of results. These will help

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doctors in diagnosing the disease and selecting the correct treatment or operation plan. However, the medical laboratory technicians accuse the statements from doctors who are not specialized in the field of laboratory of hindering them from discussing the medical information contained within the reports that are discharged by the medical laboratory. These reports are related to the results presented in different units arising from the practiced experiments and are performed under blood chemistry, blood tests, the automated blood count to extract the number of red cell hemoglobin levels, white blood cells, and platelets count in the blood, and to diagnose the morphology and diagnosis of various disease conditions.

3.1. Responsibilities and Skills Required

Lab technicians are professionals who provide a critical service in the health sector. A laboratory technician has a variety of tasks, such as testing blood samples and other body fluids, interpreting results, and providing data for clinical treatment. In addition to these tasks, it is necessary to keep records and store the samples correctly to ensure better medical care. They carry out tests by using advanced equipment and performing procedures, often evaluating the complex functions of blood cells to support and aid the diagnosis of blood diseases or other diseases. In many cases, a collection of patients' complaints and clinical judgment are associated with demographic information and physical examination and/or medical imaging to increase the suspicion of which disease. A lab test is ordered in such situations to help diagnose, monitor, confirm, and rule out any suspected disease. Blood diseases are among the most common; variation, decrease, or increase in components of blood indicate many conditions. However, examining blood is not simple, and there are many key precautions to consider in order to obtain accurate results, which is why various skills and responsibilities are required to perform tests and examine blood.

4. Challenges in Interpreting Blood Test Results

4.1. Development of Symptoms Symptoms that lead patients to visit their doctors are one of the greatest challenges in care. Specific symptoms or complaints described by the patient can put pressure on the laboratory. It is difficult to evaluate symptoms that are not specific, repeat with short or long intervals, or involve more than one of the body's systems. Laboratory requests may be repeated depending on the severity or recurrence of the complaints or the patient's noncompliance with the doctor's instructions. Repeated requests might also be ordered from different doctors. The patient might consult with a different family member about these complaints and apply to another hospital, clinic, or separate departments. Hospital admissions related to symptoms may change. The most likely disease and subsequent tests may provide guidance in obtaining accurate results by lessening stress on the laboratory. (Maisel et al.2021)(Barillari et al.2021)(Ziauddeen et al.2022)(Gallo et al.2021)(Vanichkachorn et al.2021)(Malhotra et al.2021)

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4.2. Manifestation of Signs Laboratory requests are repeated in response to some symptoms that indicate problems at first sight. The requested testing may not be entirely normal. Patients do not loudly state laboratory-related statistics. Laboratory result evaluation, the number of tests ordered for individuals, tests for primary hematology parameters, whether the test was done among lab or hospital consultations, and the age of the patient will prevent future problems. The sight of the doctor is well-trained. Through experience, the doctor might ask if a patient's redness occurred because of a laboratory error in the reagent region, or whether the presence of candidemia is indicated by a decrease in bacteria or reduction in yeast numbers. Signs above and/or below test reference values can only indicate a possible disease. Tests can only indicate the doctor's determination for the observed or speculated scope of the disease.

4.3. Concurrent Chronic Diseases No response is found in the first tests requested for chronic diseases, or for primary thresholds and important patient records. An extended Chronic Diseases Monitoring Laboratory panel would be advantageous in the management of the laboratory to form a long-term diagnosis. The responsibility for interpreting the results lies with the laboratory, depending on the number, direction, and average of the results of numerous tests ordered month by month, independent of changes in one or more parameters. Furthermore, all department illnesses increase laboratory responsibility by including other test combinations. Because of the presence of multiple concurrent problems, the need for other tests might arise from chronic systemic clinical or drug treatment. This profile increases with age. Monitoring with the evaluation of the present and evaluating the burden of the future might constitute a negative effect, regardless of the contemporary time. Blood test results are affected by the number and type of chronic diseases, including independent tests. Their preference to visit several doctors involved in the diagnosis or treatment of named chronic diseases will involve separate panels from the departments. It will require frequent monitoring or long contact with a specific doctor to make the appropriate judgment with interdisciplinary teamwork.

4.1. Complexity of Blood Disorders

The special nature of peripheral blood is that it is a "unit" from which pathologies of various organs and systems can be diagnosed. In general, disease is a dynamic process that requires the permanent accumulation of data, first of all, clinical-anamnestic data; next, paraclinical laboratory data; and finally, instrumental and morphologic research. In order to understand these phenomena, it is important to know the basic measures of "laboratory medicine" or "laboratory diagnostics". It is clear that receptors of tissue cells are in direct contact with blood and its flow a majority of the time. Blood is the "nose" of our cells and of our organ systems. These systems are extremely sensitive to slight variations in blood homeostasis. In other words, the state or function of any regulatory system is also critical. Also, blood volume

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is quite small but can include wide variations in soluble substances, from atto- to millions of molar concentrations.

Blood is not only a distribution and communication system, but its production pathway originates from an upstream cell group that is also able to adapt to signals coordinated with the consumption and theft of cells from various organs and systems. Each mature nucleated peripheral blood cell must respond to accurate regulatory signals and properly functioning cellular mechanisms that maintain the equilibrium of the systems. Also, peripheral blood cell expression depends on cell maturation along the production pathway and on the effects of the surrounding tissue environment. As a result of the described character of the interactions, it is quite complicated to detect any type of flow cytochemical expression in blood smears from "cell(s) of origin". This is why the expression phenotypes of cells at various stages of differentiation have traditionally defined both overall lineage distribution and various types of mismaturation.

4.2. Variability in Test Results

Variability in test results is a big challenge for laboratory personnel when interpreting blood tests in patients with blood disorders. This variability in the results of tests in the laboratory can be biological, analytical, or pre-analytical components. The way we handle, collect, store, and transport the samples to the laboratory contributes to the variation in the results of those tests requested. We should follow the standard protocols and procedures to minimize this variability in the test results. To reduce the variability in the rates or results, we also need to standardize the instruments, reagents, and consumables used in the laboratory, as well as standardize the personnel who perform these particular tests. Biological variability can be either intrasubject variability, which includes intra-individual variability, or between individuals, which is also known as inter-individual variability.

Intra-individual variability refers to fluctuation over time within one person, whereas inter-individual variability refers to variation between two or more individuals. From the same patient, the test results can differ at different times, or the same test coming from different individuals from the same general population may differ from each other. The variability in the results of the tests can also be grouped into biological variability, effect, and absence of disease. The laboratory is also responsible for false interpretation of the test through analytical false results, which could be due to high sensitivity from the effect of the assay or any pre-analytical factor that interferes with the results. The laboratory should emphasize each and every step that contributes to the variability of the laboratory test results. These steps should strictly follow prescribed guidelines or protocols in order to obtain a reliable and precise result for accurate interpretation.

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5. Theoretical Framework

Minimizing misinterpretation of test results through empirical knowledge, including theoretical knowledge, is the key to achieving high-quality medical laboratory work. This conceptual paper examines the underlying theoretical knowledge that is used by laboratory technicians in interpreting blood test results in patients with blood disorders. The paper argues that minimal focus has been given to the understanding of the theoretical knowledge used by laboratory technicians in interpreting test results, despite its critical importance in helping them minimize misinterpretations. Discussions on medical laboratory work and blood test interpretations are first done. A brief review of reasoning from a sociocultural perspective and the concept of the mangle of practice is then provided to argue that there are many forms of reasoning that go unrecognized simply because laboratory work has become invisible due to its routinized nature. The Moving through the Mangle of Practice framework is proposed as an argument for promoting theoretical awareness and for developing theoretical imagination in medical laboratory work.

Medical laboratory work involves collecting and distributing laboratory samples for analysis and interpreting the results for clinicians who will diagnose and treat patients. Empirical knowledge that is employed, including theoretical knowledge, is the key to achieving high-quality laboratory work. Blood is the body's river of life as it keeps our body working through the supply of oxygen, hormones, nutrients, waste removal, and so on. When patients present with blood disorders, clinical questions are often raised on whether or not the blood test results are consistent with the clinical examinations and the patients' underlying blood disorders. These clinical questions are answered by performing and interpreting blood test results. Patients suffering from blood diseases may become very sick, and even die if not recognized and treated appropriately because blood disorders impact many aspects of the body and its functions. Blood test results assist clinicians in diagnosing and monitoring blood diseases and infections. Blood tests are done in the laboratory where clinical laboratory technicians perform the tests and interpret the results. Blood test results are interpreted in the context of patients' medical histories, physical examinations, and other laboratory tests.

5.1. Key Theories and Concepts

The key theories used in the development of this theoretical study were value friction and flow theory, social practice theory, and emotion management theories. The focus of value friction and flow theory is on conflicts and tensions in professional work practices. The concept of friction is used to understand the complexity of laboratory technicians in interpreting blood test results in patients with blood disorders. The idea of technical mediating artifacts also comes from work on friction and flow, which described how various physical objects act as carriers of shared values.

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Social practice theory has been a useful framework for understanding the behaviors of laboratory technicians. Social practice theory integrates a variety of perspectives so that practices can be analyzed from theoretical positions informed by various traditions. Practices include the behaviors of interpreting blood test results in patients with blood disorders. Emotion management theories have also been useful in providing insight into the dynamics and tensions in professional work roles. Laboratory work involves multiple levels of emotion, and both people in the work role and patients and their relatives need to manage their emotions effectively to ensure the job is carried out safely. In their everyday lives, patients' family members affect the interpretation of blood test results. To date, research has largely focused on staff rather than on family members. Theoretical considerations guide the understanding of the real-life experiences of blood test result interpretation.

6. Conclusion and Future Research Directions

One of the factors that causes the challenge for laboratory technicians in interpreting blood test results is the fact that the results are not always consistent. In this theoretical study, secondary data in the form of opinions from experts was compiled. The findings presented that laboratory technicians need to fully understand the normal levels of each parameter from blood test results to have a comprehensive understanding of the diseases and the situation of patients, and to have strong reading skills and relevant knowledge in order to properly interpret the results to fit the individual patient and their illness or situation. Therefore, this study hopes to encourage people to regard the work of laboratory technicians as skilled work that needs to be well understood and supported. In conclusion, laboratory technicians play a crucial role in the process of diagnosis and patient treatment, but they face several challenges, particularly in interpreting blood test results. The situation is not helped by low interest in their work, which makes it difficult to expand their knowledge and update the data required. Therefore, this study aimed to gather the opinions of various specialist groups as a means of providing information and informing others about the challenges presented to laboratory technicians when interpreting blood test results. By understanding the valuable roles of laboratory technicians in diagnosing blood disorders, academic institutions, professional agencies, and management bodies are expected to provide them with support, further enhancing their specialist scientific roles.

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