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Medical laboratory science: Pivotal role in health component of a new emerging Nigeria

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Abstract

Medical Laboratory Science is the practice of analysing human or animal tissues, body fluids, excretions, creating biological, designing and manufacturing equipment for medical laboratory diagnosis, treatment, and research. According to the MLSCN Act, the Medical Laboratory is the place where the Medical Laboratory Scientist performs the required analysis for clinical testing. There are three types of healthcare which are the primary, secondary, and tertiary. Medical laboratory investigations performed by medical laboratory scientists are critical at all levels for preventive, diagnostic, therapeutic, and referral services. In the healthcare sector, Medical Laboratory Science is extremely important and some of their essential functions include disease diagnosis, treatment monitoring, disease prevention and control, quality assurance, and multidisciplinary collaboration. The contributions of Medical Laboratory Scientists are critical in enhancing healthcare delivery, increasing disease surveillance, advancing research, and encouraging evidence-based practices. Their knowledge and commitment shape the healthcare system by providing accurate and dependable laboratory services, thereby improving the health and well-being of the Nigerian population.

Keywords: medical laboratory science, role, health, new emerging, Nigeria

Introduction

Nigeria is a West African country that faces numerous health challenges resulting from social, economic, and political factors. These challenges include infectious diseases like malaria and cholera, maternal and child health issues, non-communicable diseases like cancer and diabetes, healthcare infrastructure, and financing (Oleribe *et al.*, 2015).

To address these challenges, a multi-faceted approach is required, which includes improving healthcare infrastructure, increasing funding for healthcare, strengthening primary healthcare systems, expanding health insurance coverage, enhancing disease surveillance and control, prioritizing maternal and child health interventions, promoting healthy lifestyles, and investing in health workforce development (Oleribe *et al.*, 2015; Uzochukwu *et al.*, 2016).

Medical Laboratory Science is a vital component of the healthcare system in Nigeria and plays a critical role in addressing these health challenges. Medical Laboratory Scientists contribute significantly to disease diagnosis, prevention, through disease surveillance, prevention, monitoring, and research (Nwadioha *et al.*, 2017). They are essential for effective disease management, public health interventions, and the provision of quality healthcare services in Nigeria.

Through their expertise in disease diagnosis and surveillance, Medical Laboratory Scientists contribute to improving healthcare outcomes, controlling infectious diseases, ensuring safe blood transfusion, and enhancing the overall quality and effectiveness of healthcare services (Nwadioha *et al.*, 2017).

Overview of medical Laboratory science

Medical Laboratory Science is a vital component of the healthcare system and plays a critical role in disease diagnosis, prevention, treatment, and monitoring. Medical Laboratory Scientists are trained professionals who perform laboratory tests

and analyze samples to diagnose and treat diseases (Nwadioha *et al.*, 2017). They use various laboratory techniques, equipment, and technologies to analyze blood, urine, tissue, and other body fluids to detect the presence of pathogens, chemicals, or other abnormalities that may indicate a disease.

e.

Medical Laboratory Science is a multidisciplinary field that encompasses various disciplines such as Clinical Chemistry, Hematology, Medical microbiology, Immunology, and Molecular biology (Nwadioha *et al.*, 2017). These disciplines work together to provide accurate and reliable laboratory results that are essential for effective disease management, public health interventions, and the provision of quality healthcare services.

In Nigeria, Medical Laboratory Science has been recognized as an essential component of the healthcare system. The Medical Laboratory Science Council of Nigeria (MLSCN) was established in 2003 to regulate and oversee the practice of Medical Laboratory Science in Nigeria (Oyeyemi *et al.*, 2016). The council is responsible for ensuring that Medical Laboratory Scientists are properly trained, licensed, and adhere strictly to professional standards.

Medical laboratory scientists work behind the scenes, performing various laboratory tests on patient samples such as blood, urine, tissue, and other body fluids. They operate and maintain sophisticated laboratory equipment, ensuring accurate and precise results. (Laposata and Lange, 2019). Their key responsibilities include:

- a. Specimen Collection: Medical laboratory scientists may be involved in collecting specimens from patients, following proper protocols and ensuring sample integrity.
- b. Sample Analysis: They perform a wide range of laboratory tests using advanced techniques and equipment to identify and measure substances or pathogens in patient samples.
- c. Quality Control: Medical laboratory scientists monitor and maintain quality control measures to ensure accuracy and reliability of test results.

They validate and troubleshoot instrumentation, reagents, and procedures (WHO, 2017).

d. Data Analysis and Interpretation: They analyze test results, interpret findings, and report the information to physicians, nurses, and other healthcare professionals. They may also assist in the diagnosis, treatment, and monitoring of diseases (ASCLS, 2021).

e. Research and Development: Some medical laboratory scientists participate in research studies, developing new laboratory methods, improving existing techniques, or exploring emerging technologies in the field.

Accurate and reliable laboratory testing plays a crucial role in various fields, including healthcare, research, and industry. This is particularly important in the field of medical laboratory science, where the roles and responsibilities of laboratory scientists involve

a) Patient Diagnosis and Treatment: In healthcare, accurate laboratory testing is essential for diagnosing diseases, monitoring patient health, and determining appropriate treatment options. Accurate test results enable healthcare professionals to make informed decisions and provide personalized care to patients. (Smith and Johnson, 2018).

b) Disease Prevention and Control: Laboratory testing is vital for identifying and monitoring infectious diseases, such as COVID-19, HIV, hepatitis, and many others. Reliable testing allows for early detection, isolation, contact tracing, and effective control measures to prevent the spread of diseases within communities (Jones *et al.*, 2020).

c) Research and Development: Laboratory testing forms the foundation of scientific research and development. Reliable test results are necessary for studying diseases, investigating new treatments, developing drugs and vaccines, and advancing medical knowledge. Accurate testing ensures the validity and reproducibility of research findings (Brown and Davis, 2019).

d) Quality Control and Assurance: In various industries, including pharmaceuticals, food and beverages, and manufacturing, accurate and reliable laboratory testing is crucial for quality control and assurance. Testing ensures that

products meet safety standards, comply with regulations, and maintain consistent quality. It helps identify any potential defects or contaminants that could pose risks to consumers or compromise product integrity (Garcia *et al.*, 2021).

e) Environmental Monitoring: Laboratory testing is vital for monitoring and assessing environmental factors such as air and water quality, soil contamination, and the presence of pollutants. Accurate testing allows for early identification of environmental hazards, enabling appropriate remediation and protective measures (Smith and Lee, 2016).

f) Forensic Analysis: In forensic science, accurate laboratory testing is critical for analyzing evidence, such as DNA samples, fingerprints, toxicology reports, and ballistics. Reliable testing can help establish guilt or innocence in criminal investigations, provide valuable information in civil cases, and contribute to the overall administration of justice.

g) Public Health Surveillance: Accurate and reliable laboratory testing is essential for public health surveillance. It enables the monitoring and tracking of disease prevalence, emerging infectious agents, and the effectiveness of public health interventions. Timely and accurate data from laboratory testing support evidence-based decision-making and the development of effective public health policies (Jones and Williams, 2020).

Health challenges in Nigeria

Nigeria faces numerous health challenges, some of which are common in many developing countries. These challenges are multifaceted and require sustained efforts from the government, healthcare providers, and the international community to address effectively. Here are some key health challenges in Nigeria:

a) Infectious Diseases: Nigeria faces a high burden of infectious diseases such as malaria, HIV/AIDS, tuberculosis, and vaccine-preventable diseases. Malaria is particularly prevalent, with Nigeria having one of the highest malaria burdens in the world. These diseases pose significant

health risks and contribute to high morbidity and mortality rates (WHO, 2020).

b) **Maternal and Child Health:** Maternal and child health indicators in Nigeria are concerning. Maternal mortality rates are high due to limited access to quality antenatal and postnatal care, skilled birth attendants, and emergency obstetric services. Infant and child mortality rates are also elevated, primarily due to preventable causes such as malnutrition, vaccine-preventable diseases, and inadequate healthcare infrastructure (UNICEF, 2019).

c) **Malnutrition:** Malnutrition is a significant health challenge in Nigeria, affecting both children and adults. Many children suffer from acute malnutrition, chronic malnutrition (stunting), and micronutrient deficiencies. Malnutrition compromises the immune system, leading to increased vulnerability to diseases and long-term developmental issues.

d) **Limited Access to Healthcare:** Access to healthcare services is a significant challenge, particularly in rural areas. There is an inadequate number of healthcare facilities, healthcare workers, and essential medical supplies. This limited access to healthcare disproportionately affects vulnerable populations, including those living in poverty, remote communities, and conflict-affected areas.

e) **Weak Health Infrastructure:** Nigeria's health infrastructure faces significant challenges, including inadequate healthcare facilities, limited medical equipment and supplies, poor sanitation, and insufficient funding. These shortcomings affect the quality and availability of healthcare services across the country.

f) **Non-communicable Diseases:** Non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, cancer, and respiratory illnesses are on the rise in Nigeria. Factors contributing to the increase include urbanization, lifestyle changes, and limited access to preventive care and treatment for NCDs (WHO, 2018).

g) **Health Financing:** Nigeria faces challenges in health financing and resource allocation. Insufficient investment in healthcare infrastructure, low healthcare spending, and inadequate health insurance coverage limit the

accessibility and affordability of healthcare services for many Nigerians.

h) **Public Health Emergencies:** Nigeria is vulnerable to public health emergencies, including disease outbreaks and natural disasters. Epidemics like cholera, Lassa fever, and meningitis continue to occur, necessitating effective disease surveillance, emergency preparedness, and response systems (WHO, 2018).

Contribution of medical laboratory sciences in Nigeria's health

Medical Laboratory Science plays a critical role in Nigeria's healthcare system and contributes significantly to improving health outcomes. Here are some key contributions of Medical Laboratory Science in Nigeria's health:

a) **Diagnosis and Treatment:** Medical Laboratory Scientists perform various laboratory tests to assist in the diagnosis and treatment of diseases. They analyze patient samples, such as blood, urine, tissue, and body fluids, using specialized techniques and equipment. Accurate and timely laboratory test results help healthcare providers make informed decisions about patient care, including selecting appropriate treatment options.

b) **Disease Surveillance and Outbreak Control:** Medical Laboratory Scientists contribute to disease surveillance and outbreak control in Nigeria. By conducting tests and analyzing samples, they detect and identify infectious agents responsible for outbreaks, monitor disease trends, and provide data for public health interventions. This information is crucial for implementing effective control measures, contact tracing, and preventing the spread of diseases.

c) **Blood Banking and Transfusion Medicine:** Medical Laboratory Scientists play a crucial role in blood banking and transfusion medicine. They ensure the safety and availability of blood and blood products for transfusion. This includes screening and testing donated blood for infectious diseases, matching blood types for transfusions, and monitoring patients for potential adverse reactions to transfusions.

d) **Research and Development:** Medical Laboratory Scientists contribute to medical research and development in Nigeria. They participate in research studies, conduct experiments, analyze data, and contribute to the scientific understanding of diseases, treatments, and new diagnostic methods. Their expertise is essential in advancing medical knowledge and improving healthcare practices.

e) **Quality Assurance and Laboratory Management:** Medical Laboratory Scientists are involved in quality assurance and laboratory management. They establish and implement quality control measures to ensure the accuracy, reliability, and validity of laboratory test results. They also maintain and calibrate laboratory equipment, manage laboratory supplies, and follow standard operating procedures to ensure the smooth functioning of the laboratory.

f) **Training and Education:** Medical Laboratory Scientists are involved in training and educating future professionals in the field. They contribute to the curriculum development, teaching, and supervision of students in medical laboratory science programs. By passing on their knowledge and skills, they help to build a competent workforce that can meet the country's healthcare needs.

g) **Public Health Education:** Medical Laboratory Scientists contribute to public health education and awareness campaigns. They play a role in disseminating information about diseases, preventive measures, and the importance of laboratory testing. By educating the public, they help promote healthy behaviors, disease prevention, and early detection of illnesses.

Impact of medical laboratory science on public health

Medical laboratory science has a significant impact on public health. Here are some key ways in which medical laboratory science contributes to public health:

a) **Disease Detection and Surveillance:** Medical laboratory scientists play a crucial role in the detection and surveillance of diseases. Through laboratory testing, they identify the

presence of infectious agents, such as bacteria, viruses, and parasites, responsible for various diseases. This information helps public health authorities track disease patterns, identify outbreaks, and implement appropriate control measures.

b) **Early Diagnosis and Treatment:** Medical laboratory scientists provide valuable diagnostic information that enables early detection and treatment of diseases. Accurate and timely laboratory test results help healthcare professionals make informed decisions about patient management and initiate appropriate treatment interventions promptly. Early diagnosis leads to improved health outcomes, reduces the risk of complications, and helps prevent the spread of diseases.

c) **Monitoring Disease Trends and Response:** Medical laboratory scientists contribute to monitoring disease trends and evaluating the effectiveness of public health interventions. By analyzing data from laboratory tests, they provide critical information on the prevalence and distribution of diseases within populations. This data assists public health authorities in understanding disease patterns, identifying high-risk groups, and developing targeted interventions to control and prevent the spread of diseases.

d) **Outbreak Investigation and Control:** During disease outbreaks, medical laboratory scientists play a vital role in identifying the causative agents, characterizing the outbreak, and implementing control measures. They conduct laboratory tests on patient samples, trace the source of the outbreak, and provide crucial information to guide public health responses. Their contributions help to contain outbreaks, protect communities, and minimize the impact of infectious diseases on public health.

e) **Vaccine Development and Monitoring:** Medical laboratory scientists contribute to the development and monitoring of vaccines. They conduct research, perform tests to evaluate vaccine efficacy and safety, and monitor immune responses in vaccinated individuals. This information supports the development of effective vaccines and ensures their quality and effectiveness in preventing diseases (NIMR, 2020).

f) **Environmental and Occupational Health:** Medical laboratory scientists play a role in assessing and monitoring environmental and occupational health hazards. They analyze samples from air, water, soil, and workplace environments to identify potential contaminants, toxic substances, or occupational exposures that may pose health risks to the public. This information helps inform public health policies and interventions to protect communities and workers from harmful environmental and occupational factors (NIMR, 2020).

g) **Health Education and Promotion:** Medical laboratory scientists contribute to health education and promotion efforts. They provide valuable information about diseases, diagnostic tests, preventive measures, and the importance of laboratory testing. By educating the public, healthcare providers, and policymakers, they help raise awareness, promote healthy behaviors, and empower individuals to make informed decisions about their health.

Challenges and opportunities

Challenges and opportunities exist within the field of medical laboratory science. Let's explore some of them:

Challenges

Shortage of Skilled Workforce: Many regions, including Nigeria, face a shortage of skilled medical laboratory scientists. Insufficient training programs and limited resources for education and professional development contribute to this challenge. The shortage hampers the capacity to meet the growing demand for laboratory services and can lead to delays in diagnosis and treatment.

Limited Access to Resources: Medical laboratory science relies heavily on equipment, reagents, and supplies to conduct tests accurately. However, limited access to these resources, particularly in resource-constrained settings, can impede laboratory operations and compromise the quality of testing. Inadequate funding for laboratories exacerbates this challenge.

Technological Advancements: While technology has the potential to revolutionize medical laboratory science, it can also present challenges. The rapid evolution of diagnostic technologies requires continuous training and upgrading of skills among laboratory professionals. Furthermore, acquiring and maintaining advanced equipment can be costly, particularly in low-resource settings.

Quality Assurance: Ensuring the quality and accuracy of laboratory testing is critical. However, maintaining robust quality assurance programs can be challenging due to limited resources, inadequate supervision, and adherence to standardized protocols. Failure to maintain quality standards can lead to erroneous results and compromise patient care.

Evolving Disease Patterns: As disease patterns evolve, medical laboratory scientists need to stay updated on emerging infectious diseases, antimicrobial resistance, and other health threats. This requires ongoing education, training, and research to adapt laboratory practices and diagnostic methods accordingly.

Opportunities

Technological Advancements: Despite the challenges, advancements in technology offer significant opportunities for medical laboratory science. Automation, molecular diagnostics, point-of-care testing, and telemedicine are some areas where technology can enhance laboratory efficiency, accuracy, and accessibility.

Collaborative Research: Collaboration between medical laboratory scientists, researchers, and other healthcare professionals can drive innovation and improve patient care. By working together, they can develop new diagnostic methods, validate novel technologies, and contribute to medical breakthroughs.

Capacity Building: Investments in training and education can help address the shortage of skilled medical laboratory scientists. Expanding educational programs, providing scholarships, and

offering continuous professional development opportunities can enhance the workforce's expertise and capacity (WHO, 2017).

Strengthening Laboratory Networks: Establishing and strengthening laboratory networks can improve resource sharing, quality assurance, and data exchange. Collaborative efforts among laboratories can enhance efficiency, standardization, and support the timely response to disease outbreaks and public health emergencies (NIMR, 2020).

Integration of Laboratory Services: Integrating laboratory services with healthcare systems can improve patient care and health outcomes. Collaboration between laboratory professionals and other healthcare providers allows for seamless communication, efficient test ordering and result reporting, and better integration of laboratory data into patient management.

Public-Private Partnerships: Partnerships between public and private sectors can bring together resources, expertise, and innovation to address challenges in medical laboratory science. Public-private collaborations can help improve access to resources, develop innovative solutions, and strengthen the overall laboratory infrastructure.

Strategies for enhancing medical laboratory in Nigeria

Strengthening Education and Training: Focus on expanding and improving medical laboratory science education programs. This includes increasing the number of training institutions, enhancing curriculum development, and providing more practical training opportunities for students. Collaborating with international partners and organizations can offer support and resources for capacity building.

Workforce Development: Implement initiatives to address the shortage of skilled medical laboratory professionals. This can involve improving recruitment and retention through competitive salaries, career advancement opportunities, and incentives. Establishing continuing professional

development programs helps update knowledge and skills in line with technological advancements.

Infrastructure and Equipment: Invest in laboratory infrastructure by providing adequate facilities, equipment, and supplies. This includes acquiring modern laboratory equipment and ensuring proper maintenance. Securing government support and partnerships with international organizations can help secure funding for infrastructure development and technology acquisition.

Quality Assurance: Establish and strengthen quality assurance programs to ensure accurate and reliable laboratory testing. This involves implementing standardized protocols, conducting regular proficiency testing, and developing robust internal and external quality control systems. Promote laboratory accreditation to enhance quality standards and confidence in laboratory services.

Research and Development: Encourage research and development in medical laboratory science to drive innovation and evidence-based practice. Foster collaboration between researchers, laboratory professionals, and healthcare providers to address local health challenges, develop new diagnostic methods, and validate emerging technologies. Provide research funding and grants to support these initiatives.

Information Systems and Data Management: Improve information systems and data management in laboratories. Implement laboratory information management systems (LIMS) for efficient test ordering, result reporting, and data storage. Integration with electronic health record systems facilitates seamless communication between laboratories and healthcare providers, enhancing patient care and public health surveillance.

Public-Private Partnerships: Foster collaborations between public and private sectors to leverage resources and expertise. Public-private partnerships can support infrastructure development, technology transfer, and training

programs. Engage with private laboratories and industry stakeholders to establish quality standards, promote best practices, and encourage knowledge sharing.

Advocacy and Policy Support: Advocate for increased recognition and support for medical laboratory science at the national level. Engage policymakers to prioritize investment in laboratory infrastructure, education, and workforce development. Strengthen the regulatory framework to ensure adherence to quality standards and ethical practices in the field (NIMR, 2020).

Conclusion

In conclusion, accurate and reliable laboratory testing is crucial for Nigeria's healthcare system and public health. Medical laboratory science plays a vital role in disease detection, diagnosis, surveillance, and treatment. Enhancing the sector requires strategies such as strengthening education, improving infrastructure, implementing quality assurance measures, promoting research and development, and fostering public-private partnerships. By investing in the medical laboratory sector, Nigeria can improve healthcare outcomes, enhance disease control efforts, and protect public health.

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