ISSN: 2536-7153 SJMLS

Sokoto Journal of Medical Laboratory Science 2024; 9(2): 36 - 44

SJMLS-9(2)-005

# A Review on The Trend of Medical Laboratory Scientists Training in Africa

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https://dx.doi.org/10.4314/sokjmls.v9i2.5

**Summary**
This review examines the evolution, challenges, and future directions for strengthening Medical Laboratory Scientist training in Africa. Well-trained professionals are crucial for effective healthcare delivery. This analysis highlights the historical context, current state, and ongoing challenges in Medical Laboratory education across the continent. Medical Laboratory Scientists play a vital role in patient care by informing diagnosis, identifying infectious diseases, ensuring blood safety, and enabling public health initiatives. Training has progressed from the colonial-era on-site instruction to formal university programs and diploma courses. Recent efforts include curriculum revisions, accreditation systems, and technology integration. Current challenges include infrastructure limitations, access to laboratories and technology, faculty and workforce shortages, and graduate retention hinder training effectiveness. Emerging practices like virtual microscopy, simulation training, and international partnerships are improving training methods. Strengthening training requires infrastructural development, industry collaboration, continuous improvement cycles, technology integration, and curriculum harmonization. Transforming Medical Laboratory training requires establishing strong regulatory bodies, strategic plans, standardized curricula, practical training opportunities, and increased funding.

**Keywords**: medical laboratory, training, evolution, curriculum review.

## Iintroduction

The critical role of well-trained Medical Laboratory Scientists and professionals in healthcare systems globally cannot be overstated. Particularly in Africa, strengthening laboratory systems and building capacity is instrumental to tackling endemic diseases, HIV/AIDS, rising non-communicable diseases and the capacity to detect and respond to disease outbreaks (Alemnji *et al.*, 2014). This review analyses trends, evolution, challenges, and future recommendations to sustainably strengthen Medical Laboratory education across Africa amidst goals to expand universal health coverage.

## The Start of Modern Medical Laboratory Science in Africa

Medical laboratory services in Africa have evolved since the colonial era, but still face challenges around accessibility, infrastructure, staffing, quality, and sustainability. During the late 1800s and early 1900s under colonial rule, basic health facilities emerged with limited laboratory capabilities. Tests largely comprised microscopy for diseases like malaria and trypanosomiasis (Petti *et al.,* 2006).

Across Africa, medical laboratory services were primarily managed by laboratory aides and assistants during colonial eras, concentrated in urban hospitals serving colonial interests (Bates *et al.*, 2004). After independence starting in the 1950s, African countries began investing to develop professional laboratory training programs, although still very centralized to urban centres and hospitals (Petti *et al.*, 2006).

In the 1980s, the rise of HIV/AIDS, resurgence of TB and malaria drug resistance would expose the need to radically decentralize and expand

laboratory systems (Muhibi *et al.*, 2012). The World Health Organization Regional Office for Africa (WHO AFRO) strategic plan 2002–2007 galvanized policy attention on medical laboratory services as critical to tackling priority diseases and achieving health-related development goals (WHO, 2002). This paved way for growing external investments and partnerships to transform medical laboratory education continent-wide.

In recent decades, strengthening laboratory systems has resurfaced as key for effective public health and clinical care in Africa. Initiatives like the WHO's AFROSLAB and SLIPTA programs have promoted quality management frameworks like ISO 15189 standardization (WHO, 2020). External investments have supported equipment provision, infrastructure upgrades like cold chain systems, and training programs to grow specialist expertise and retention. Some countries have adopted laboratory policies and strategic plans supporting universal health coverage. However, over 70% of clinical decisions still rely on presumptive diagnosis without laboratory confirmation (Muhibi, 2010; WHO 2020). Persistent gaps exist around regulation, connectivity, sustainable financing, instrument maintenance, and shortages of qualified workforce (Ondari *et al*., 2022).

**Importance of Medical Laboratory Scientists in Healthcare**

Medical Laboratory Scientists play a crucial behind-the-scenes role in healthcare. Some key ways they contribute to patient care and health outcomes are highlighted below.

Informing Diagnosis and Treatment Decisions: By performing tests on clinical specimens, Medical Laboratory Scientists provide critical data to physicians on pathogens, biomarkers, genetic mutations and more that give essential insights for accurately diagnosing conditions and optimizing treatment plans (Pai *et al.*, 2012).

Identifying Infectious Disease Threats: Through testing patient samples along with surveillance screening, medical laboratory scientists are often in the frontline for the recognition and characterization of emerging infectious diseases like COVID-19 or antibiotic resistant bacteria to facilitate rapid public health response (ASCP, 2022).

Ensuring Safe Blood Supply: From initial blood grouping and compatibility testing to indispensable screenings for pathogens like HIV and hepatitis, Medical Laboratory Scientists crucially support blood banks in maintaining a safe blood supply for vulnerable patients (Kuruvilla, 2022).

Enabling Population Health Initiatives: Laboratory data fuels epidemiologic surveillance and research that guides key public health priorities like infectious disease control, chronic disease monitoring, immunization coverage, maternal & child health metrics and environmental protection against toxins/ carcinogens (APHL, 2022).

**Early Developments in Evolution of Medical Laboratory Scientists Training in Africa**

The evolution of medical laboratory education and training in Africa has faced numerous challenges but seen some key milestones, including:

Formal Degree Programs: In the 1920s, additional bachelor's and associate degree programs specifically focused on clinical laboratory techniques began emerging at universities to train skilled civilian personnel and further standardize the fledgling occupation (Keogh, 2014).

Colonial Era Cursory Training (early 1900s): Under colonial regimes, rudimentary lab testing capabilities were established with basic often non-standardized onsite instruction for local assistants conducting simple microscopy and bacteriology tests (Adetifa, 2021).

Independence Era Expansion (1960s onwards): As African countries developed health systems after independence, more formalized national training programs were introduced, such as Medical Laboratory Science schools in Nigeria and Ethiopia. However, progress was hindered by war and economic factors (Petti *et al.*, 2006).

External Investments (2000s): Various international development efforts have upgraded facilities, donated equipment, supported

curriculum revisions, and funded workshops to expand workforce capacity. Certification systems are gradually emerging (Ondari *et al.*, 2022).

Regional Harmonization (2010s and beyond): Collaboration between African countries to share best practices and enable mobility across regional laboratories helped to slowly harmonize training standards and improve quality. But regional self-sufficiency remains a challenge (WHO, 2020). Sustained political will and investments into both infrastructure and people remain vital for further advancement.

**Current Status in the Training of Medical Laboratory Scientists in Africa**

The training of Medical Laboratory Scientists in Africa has seen some recent positive developments, but ongoing challenges around standardization and technology integration persist:

Accreditation & Certification: Accreditation systems are still emerging in most countries - South Africa currently leads with 23 accredited programs. Regional collaboration initiatives to support program reviews and shared qualifying examinations across Anglophone, Francophone and Lusophone Africa are working to harmonize certification (Adetifa, 2021). Nigeria accreditation system also evolved steadily with stringent factors being captured in the Medical Laboratory Accreditation Checklist administered by Medical Laboratory Science Council of Nigeria (Muhibi *et al.*, 2010).

Curricular Revisions: Various schools across Africa have recently updated medical laboratory science curricula to align with international standards from the International Federation of Biomedical Laboratory Science and the WHO-AFRO competency frameworks. But implementation gaps remain around resources. (Makani *et al*., 2022). West Africa Health Organization approved a six-year Doctor of Medical Laboratory Science (MLSD) curriculum in 2010, to prepare Medical Laboratory Scientists for ever-demanding and highly dynamic responsibilities (Adeyemo and Olusanya, 2013; Osei-Lah *et al*., 2016). This curriculum was adopted for training in Ghana recently (Osei-Lah *et al*., 2016). The West African Postgraduate College of Medical Laboratory Science, a creation of ECOWAS, has since endorsed and recommended same curriculum; while emphasizing the need for specialization at postgraduate level only (WAPCMLS, 2023).

Technology Integration: Donor investments have enabled more instructors to integrate virtual microscopes, online databases, and simulation equipment to improve teaching. However wider usage is hindered by connectivity issues, electricity reliability, and availability of consumables. (Walimbe & Kulkarni, 2020).

Sustainability & Mobility: Programs like inter-country placements and regional exams aim to enable skill transfer while building self-sufficiency, but graduate retention continues to be an obstacle for many less-resourced countries. (Ondari *et al.*, 2022). There are established facts that strong collaboration in training and biomedical research exists across the West African sub-region; and this is further strengthened with the activities of WAPCMLS.

**Trends in Training Models and Curricula Reform in Africa**

Tanzania, Nigeria, Ethiopia, Ghana and other nations with established Medical Laboratory Sciences university departments have updated their Bachelor of Science (BSc degree curricula over decades to strengthen molecular biology, genetics, immunology, biochemistry, and management competencies suiting growing diagnostics automation (Makani *et al.*, 2003; Uneke *et al.*, 2010). Program durations range between 4-6 years depending on university policies on internships or thesis inclusion. Reviews highlight need to enhance curricula on biosafety, quality systems, research skills and leadership capabilities (Nabukenya *et al.*, 2019; Adetifa, 2021). Still, degree programs face sustainability issues around implementing practical attachments, acquiring reagents and infrastructure, and graduate unemployment rates (Kasolo *et al.*, 2013; Nguyen *et al.*, 2017).

For mid-level Medical Laboratory Practitioners (MLPs), varying structured 6–24-months diplomas exist, like Kenya's Medical Laboratory

Technician courses, Tanzania's two-year Laboratory Technologists curriculum, and 12–27-month courses in countries like Ghana, Nigeria and Zambia (Kuom *et al.*, 2014; Muhibi, 2018). Partnerships to standardize technician-level curricula include the WHO-AFRO harmonized competence-based curricula for MLTs, and East African Community's (EAC) common curricula to enable professional mobility between Kenya, Uganda, Tanzania, Rwanda and Burundi with exams administered through joint Board of Examiners (WHO-AFRO, 2009, EAC 2011). Reviews praise increased private sector and distance education providers, but cite outdated curricular content, limited clinical attachments and training equipment for personnel not employed in ministries of health (Nyambose *et al.*, 2002; Nabukenya *et al*., 2019).

At peripheral levels, short courses were crucial to immediately deploy lower-level testing assistants to expand HIV rapid testing with AIDS crisis. Duration, titles, and curricula content varies immensely among nations and implementing agencies ranging from local NGOs, health professional bodies, ministries of health or medical training institutes. Core common training packages were eventually designed such as WHO AFRO SLMTA curriculum focusing on quality systems (WHO, 2011). Still reviews find inconsistent funding, regulation, and career pathways for lower cadres (Diez *et al*. 2018).

Here is an overview of typical curriculum and core competencies covered in the training of Medical Laboratory Scientists in Africa:

Curriculum Overview: Bachelor's level medical lab science programs in Africa generally span 3-5 years on a full-time basis and integrate classroom-based courses with hands-on clinical rotations under supervision in a teaching hospital or reference laboratory (Adetifa, 2021; WAPCMLS, 2023).

Foundational Sciences: Foundation coursework includes physics, chemistry, biological sciences, statistics and quantitative methods, an introduction to lab operations, biosafety and quality systems, pharmacology, biomedical research ethics, physiology, biochemistry, anatomy, biostatistics, healthcare logistics and supply chain management, instrumentation, pre-analytical specimen handling and other fundamental theory (Muhibi, 2028; Makani *et al.*, 2022).

Specialized Laboratory Techniques: Students complete courses and practicums focused on major laboratory disciplines including haematology and coagulation, clinical chemistry, diagnostic microbiology, transfusion science and blood banking, histopathology, immunology, molecular diagnostics, advanced serology, and more around specimen analysis, testing methodology and test interpretations (Muhibi *et al*., 2019; WHO-AFRO, 2020).

Professional Skills: Curricula also incorporate skills in laboratory management, communication, ethics, quality assurance, and often some basic epidemiology and public health for understanding integration with clinical and population health programs (Makani *et al.*, 2022).

Challenges in Medical Laboratory Scientists Training in Africa

Several key challenges constrain Medical Laboratory Scientist training and education systems in many parts of Africa:
Infrastructure Limitations: Frequent electricity shortages, inadequate learning facilities, and limited access to basic amenities like internet connectivity and transport particularly in rural programs heavily impact teaching capacities (Makani *et al.*, 2022).

Access to Laboratories & Technology: Outdated or non-functioning instrumentation due to irregular maintenance and supply chain issues pose a barrier, as do shortages of necessary reagents, consumables, and specimens needed for effective applied training using modern techniques (Yao *et al.*, 2018).

Faculty & Workforce Shortages: Few Ph.D level faculty members and subject matter experts are produced locally to teach specialist topics or spearhead curriculum updates based on the latest global advances and standards. Heavy workloads and low salaries deter academia careers (Munjoma *et al*., 2022).

Retention & Professional Development: Limited funding for continued faculty education, conference travel, research opportunities and skills upgrading hinders teaching effectiveness, as does high attrition of graduates and experienced instructors drawn abroad by public/private sectors (Mullei *et al.*, 2021).

Recent Innovations in Training of Medical Laboratory Scientists

Some recent innovations and best practices that are gradually strengthening Medical Laboratory Scientist training in parts of Africa include:

Emerging Training Methodologies: Increased integration of virtual microscopes, multimedia tools, e-learning platforms, and simulation equipment to enable repeated hands-on practice is improving teaching amid resource constraints in programs like those at universities in Nigeria, Sudan, and South Africa (Ige *et al.*, 2021).

Simulation & Practical Training: Approaches like student rotations through networked district hospital laboratories, use of specimen archives, and basic mannequins/models for techniques like phlebotomy offer alternative practical training avenues where access to working instrumentation is limited (Mullei *et al.*, 2021).

International Exchange Programs: Partnerships facilitating faculty and student exchanges like the NEPAD laboratories for Life program between North African and European universities promote skill transfer and adoption of new curricular elements. Similar networking exists across Anglophone and Francophone programs (Makani *et al.*, 2022).

Joint Research Initiatives: Cross-institutional research collaborations enable access to funding, specialist expertise, analytical infrastructure, and global health datasets to build local capacity and evidence guiding teaching updates. But these are still emerging gradually (Nkengasong & Ondari, 2022).

**Key Challenges and Bottlenecks**

Weak and inconsistent regulatory frameworks: Poor regulatory environments result in immense variations in scientist, technician or assistant level duration, examination, certification, licensure policies and practice scope. Many nations lack functioning laboratory professional regulatory bodies leading to proliferation of questionable private institutions and qualifications (Makani *et al.*, 2003; Nguyen *et al.*, 2017).

Verticalized, disease-specific focus: External partner investments prioritize few selected diseases such as HIV, TB, and malaria testing capacities (Ondoa *et al.*, 2017). This results in overall fragmentation rather than integrated development of multi-disciplinary medical laboratory systems continentally. Siloed development of capacities constrains responding to new outbreaks or non-communicable testing demands (Nkengasong & Nsubuga, 2020).

Theoretical learning gaps: All tiers of training curricula often have inadequate practical attachments, up-to-date equipment access for hands-on learning and balances between theoretical and practical competencies (Nyambose *et al.*, 2002). Study durations are often short given theoretical content expected to be covered, affecting skills consolidation.

Sustainability challenges: Medical laboratory training institutions and programs heavily depend on external partner funding and scholarships which threaten sustainability when project-based financing ends (Kasolo *et al.*, 2013). This contributes to lean government budget allocation for health training systems. There are also systemic constraints around student loan schemes reaching medical laboratory students in many nations.

Low attraction and retention: Severe mid-level to senior medical laboratory professional shortages across District, Regional and National referral hospital laboratories due to issues like low remuneration, poor career advancement pathways, lack of graduate internship positions and weak retention strategies within public sector health systems compared to clinical specialties (Nyambose *et al.*, 2002; Nguyen *et al.*, 2017).

**Recommendations and Conclusion**

It is recommended that Medical Laboratory Science training in Africa is further strengthened.

Infrastructure Development: Expanding access to sustainable supplies, internet connectivity, reliable utilities, modern equipment, specimen archives, and quality assurance programs should be prioritized through increased funding and public-private partnerships (Ige *et al*., 2021).

Industry & Research Collaboration: Enhanced engagement and exchanges between academic institutions, commercial diagnostic companies, reference laboratories, policy bodies and research networks can support technology transfers, curriculum updates, trainer exchanges, data access, and career pathways (Makani *et al*., 2022).

Continuous Improvement Cycles: Regular program reviews informed by faculty-student feedback, alumni placement data, university assessments and comparisons to emerging best practices can guide ongoing quality enhancements. Curriculum revisions should be continuous (Walimbe & Kulkarni, 2020).

Technology Integration: Updating materials to leverage virtual simulations, e-learning tools, telepathology platforms and data literacy instruction will enable training at scale amid resource constraints while aligning to global competency standards (Nkengasong and Ondari, 2022).

Harmonization of Curriculum: Harmonizing the training curriculum to produce non-specialist, high level manpower is achievable by embracing MLSD curriculum for training Medical Laboratory Scientists.

In conclusion, transforming medical laboratory health professional training to be equitable, responsive, and sustainable in Sub-Saharan Africa requires holistic interventions:

Establish and strengthen regulatory bodies for setting and enforcing laboratory practice standards, examination policies, personnel licensure or registration frameworks and quality assurance across tiers.

Set up long-term, government-led strategic plans for gradually developing integrated laboratory systems with prioritized, costed milestones to absorb more locals into the workforce. This must cut across priority disease and general testing capacities.

Standardize and update Medical Laboratory Sciences university curricula across member states for mobility per established East African and other inter-country collaborations. Enhance aspects like research methods, molecular diagnostics, quality control and biosafety.

Expand medical laboratory attachments, practical infrastructure, equipment, and simulated learning in both university Medical Laboratory Sciences departments as well as mid-level training institutes.

Purposefully increase funding to establish more government-sponsored Medical Laboratory Sciences university departments and mid-level training institutes to boost locally trained personnel and program sustainability.

Progressively strengthening medical laboratory systems across all levels demands increased domestic funding, South-South partnerships for training capacities, and bold public sector health workforce reforms for motivation, retention, and improved personnel: equipment ratios in national reference facilities cascading downwards.

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**Citation**. Muhibi Musa Abidemi, Olaniyan Mathew Foloranmi, Muhibi Mutmainah Opeyemi. A Review on The Trend of Medical Laboratory Scientists Training in Africa. ***Sokoto Journal of Medical Laboratory Science*; 9(2): 36 – 44.** https://dx.doi.org/10.4314/sokjmls.v9i2.5