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Original Research Article

A REVIEW: PERSONNEL MANAGEMENT IN LABORATORY PRACTICES: CHALLENGES AND STRATEGIES

Authors: Francis Victor Akoma[1], Oritsebinone, Esther Imoh[2], Edache Bernard Ochekwu[3], Sofolabo Adekunle Oyemade.[4]

Affiliations: [1]Department of Physics with Electronics Technology, School of Science Laboratory Technology, University of Port Harcourt, Rivers State, Nigeria.
[2]Department of Industrial Chemistry and Petroleum Technology, School of Science Laboratory Technology, University of Port Harcourt, Rivers State, Nigeria.
[3]Department of Plant Science and Biotechnology. University of Port Harcourt, Rivers State, Nigeria.
[4]Department of Physics with Electronics Technology, School of Science Laboratory Technology, University of Port Harcourt, Rivers State, Nigeria.
Corresponding Author: Email: victor.francis@uniport.edu.ng

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ABSTRACT
Background: Laboratories are essential to healthcare, research, and public health infrastructure. Yet, the sustainability of laboratory systems is increasingly threatened by chronic workforce challenges, particularly in low- and middle-income countries (LMICs).
Methods: This review synthesizes recent literature (2020–2025) to examine global and regional patterns in laboratory personnel management. Key challenges include staffing shortages, automation-driven skill gaps, fragmented training systems, ineffective leadership, and policy deficits. Drawing from studies in Nigeria, the United States, South Korea, and global consortia, this paper evaluates strategic innovations in workforce planning, continuing professional development (CPD) integration, inclusive leadership, and cross-sector partnerships.
Recommendation: Recommendations include harmonized CPD policies, automation-ready curricula, participatory governance, and inter-institutional collaboration.
Conclusion: The findings offer a pathway for laboratories to build resilient and future-ready human resources.

Keywords: Laboratory workforce, Personnel management, Health systems, Nigeria, Automation, CPD, Global health, Leadership in laboratories, Health policy

INTRODUCTION

Personnel management is critical to the efficacy, accuracy, and safety of laboratory practice, especially in diagnostic, clinical research, biomedical innovation, industrial and public health surveillance.(Department of Publications and

Extensions, Kampala International University, Uganda & Alum, 2024). Laboratories are knowledge-intensive and highly-important settings where even small personnel-related mistakes can lead to errors, misdiagnosis, safety violations, or compromised research integrity. Thus, good staff management is essential in ensuring long-term excellence in quality, bringing about regulatory compliance, and implementing professional accountability (Nam & Park, 2025). Laboratory science's operational milieu has experienced an evolutionary revolution in the last decade, fueled by the heightened uptake of Total Laboratory Automation (TLA), digital health informatics, biosafety frameworks, and the COVID-19 pandemic's pervasive impacts (Dabla *et al.,* 2021). These changes have not only broadened the range of laboratory possibilities but also reshaped workforce expectations and management issues around the world.

Successful laboratory workforce management demands recruitment, training, rostering, appraisal, and retention tasks that are both subject to national law and international laboratory accreditation standards. Yet, in the developed and developing world, such tasks are commonly compromised by structural inefficiencies, budgetary constraints, and rapid technological change(Cangiano *et al.,* 2013; Essuman *et al.,* 2023). In developed nations, for instance, some of the most influential concerns include the replacement of laboratory technicians through automation, the rise of hybrid skill requirements (e.g., data science in bioinformatics laboratory), growing burnout of specialists, and aging of key technical personnel (Daneault *et al.,* 2025). Whereas genomics sequencing and AI-driven diagnostics are some of the newer emerging technologies, labs today are being called on to provide quicker, more precise, and more scalable outcomes requiring more responsive and more skilled labor models than ever (Dabla *et al.,* 2021).

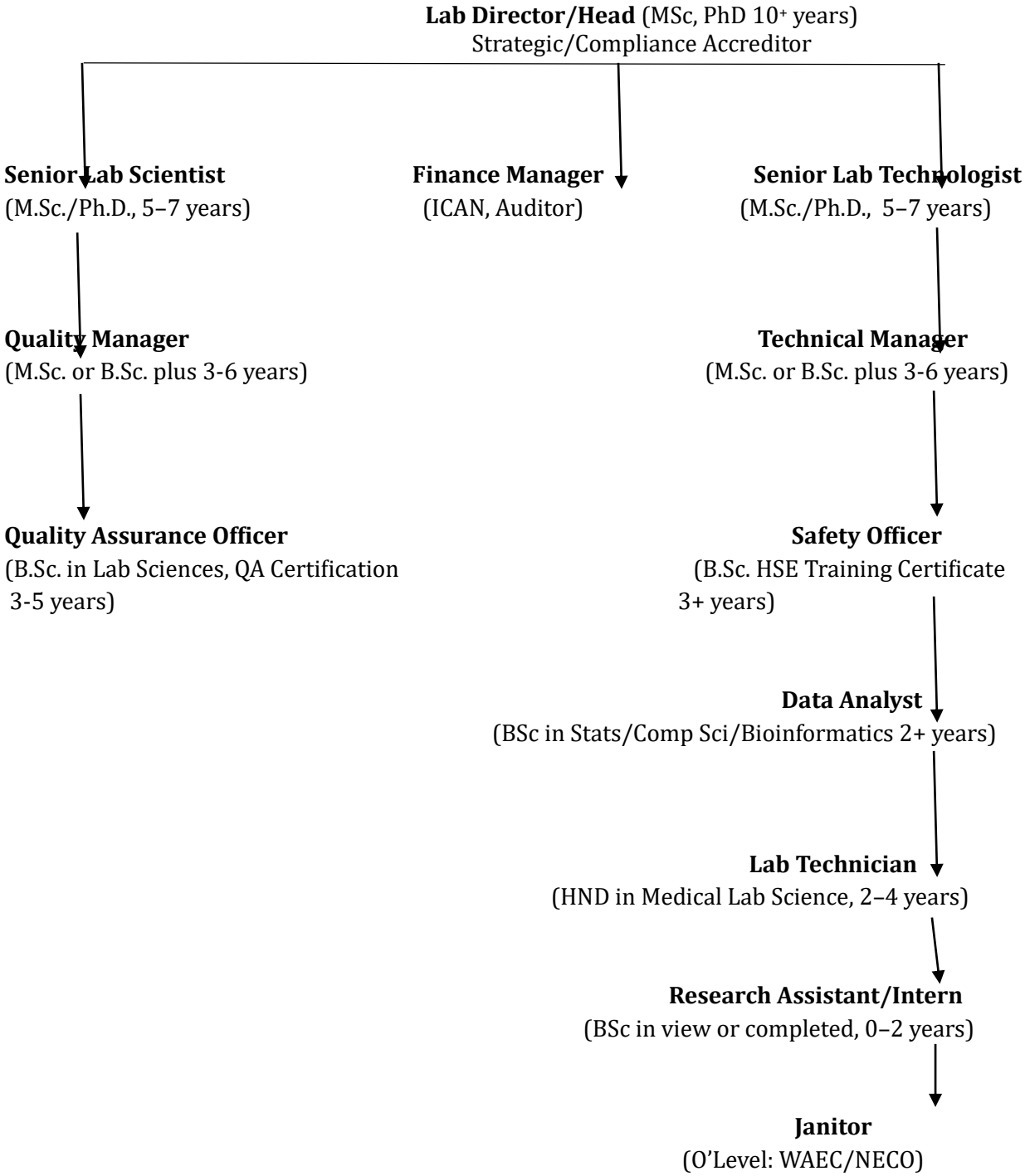
A look at the other side of event, resource-poor environments like Nigeria struggle with another but related set of issues. These include erratic funding of laboratory services, outdated infrastructure, limited access to continuing education, and weak professional regulation (Howard *et al.,* 2019). (Adonye & Adonye, 2023) determined that laboratories in Nigeria commonly operate with supply chain volatility with regard to consistently not having secure access to reagents, consumables, and equipment maintenance services. These operational challenges are also combined with low salaries, employment insecurity, and few possibilities for specialization or professional growth. Under these conditions, laboratory personnel tend to have poor morale, low productivity, and high turnover rates challenges that weaken general effectiveness and sustainability of diagnostic systems.

The problems with Nigerian laboratories are not certainly financial or technical but systemic (Adonye & Adonye, 2023). Nigerian public sector laboratory facilities suffer, for example, from chronic shortages of personnel. This leads to overloads, fatigue, and delays in diagnostics, which are common, particularly during public health emergencies. (Adonye & Adonye, 2023; Dovlo, 2005) opined that inefficient staffing deployment, maldistribution of health professionals between rural and urban areas, and ongoing migration of skilled workers to richer nations—the feared "brain drain"—contribute to the burden. These challenges reduce diagnostic turnaround times, undermine bio-surveillance activities, and hamper Nigeria's capacity to prepare for the occurrence of Lassa fever, cholera, or future pandemics. Notwithstanding all these difficulties, both global and local initiatives have promoted the evolution of efficient personnel management practices that try to improve laboratory productivity. They incorporate continuous professional development (CPD), cross-functional training, formal mentoring, and the introduction of e-learning modules for laboratory personnel (Nam & Park, 2025). Moreover, there has been the introduction of workforce planning tools as well as laboratory information management systems (LIMS) in some African contexts to improve scheduling and reduce human error. Global collaborations have, especially, enabled the introduction of stepwise laboratory quality improvement processes using frameworks such as SLIPTA (Stepwise Laboratory Quality Improvement Process Towards Accreditation), which have personnel competencies as one of the foundation pillars (Adonye & Adonye, 2023; Dovlo, 2005).

In Nigeria, however, there is uneven uptake of these measures due to infrastructural limitations and piecemeal policy implementation. Long-term investment in laboratory human resource capacity building, particularly in emerging fields such as molecular diagnostics, digital pathology, and biosafety-level laboratory practices, is urgently needed (Perrone *et al.,* 2024). National policy must also support the retention of experienced staff through incentive structures, academic appointments, and international exchange programs. The coordination of public health laboratories and university laboratories can supply joint training programs and research fellowships to create a stable personnel pool. Worldwide, the way forward in the management of laboratory staff is toward flexible and open systems that will be able to absorb new technology, new health priorities, and a changing workforce profile. Experience from high-income countries is valuable but needs to be translated to environments such as Nigeria, where low-level laboratory systems are only now coming to maturity. Comparative insight into Nigerian and international experience is therefore needed—not just for the

sake of comparing progress but also for defining scalable, locally applicable solutions. This paper presents the status of laboratory human resource management by exploring common challenges and evaluating context-specific strategies that enable efficiency, sustainability, and resilience. The article is based on current research from Nigerian and international literature and presents a comprehensive evaluation of best practices, policy gaps, and operational innovations that can shape the future of laboratory human resource management.

Organogram of a Laboratory



Executive Leadership

Head / Lab Director (M.Sc., Ph.D., 10+ years)

- Strategic direction, research direction, institutional representation, funding/grant management.

Strategic / Compliance Accreditor
- Ensures compliance with national and international laboratory regulations, quality, and safety requirements.

Senior Management
Senior Lab Scientist (M.Sc. /Ph.D., 5–7 years)
- Directs scientific research, manages senior lab personnel, ensures experimental accuracy and record-keeping.

Senior Lab Technologist (M.Sc. /Ph.D., 5–7 years)
- Oversees technical activities, equipment calibration, method development, and reporting.

Finance Manager (ICAN-certified, Auditor)
- Manages budgets, financial reporting, audits, and procurement.

Mid-Level Operations
Quality Manager (M.Sc. or B.Sc. + 3–6 years)
- Oversees quality assurance programs, SOPs, regulatory compliance, and lab certifications.

Technical Manager (M.Sc. or B.Sc. + 3–6 years)
- Supervises lab maintenance, infrastructure, IT systems, and equipment upgrades.

Quality Assurance Officer (B.Sc. + QA Certification, 3–5 years)
- Implements QA/QC protocols, internal audits, and corrective actions.

Safety Officer (B.Sc. + HSE Certificate, 3+ years)
- Performs safety drills, MSDS management, PPE monitoring, and enforces laboratory safety regulations.

Support and Specialized Staff
Data Analyst (B.Sc. in Statistics/Computer Sci/Bioinformatics, 2+ years)
- Performs data mining, statistical analysis, modeling, and report generation.

Lab Technician (HND in Medical Lab Science, 2–4 years)
- Performs routine tests, sample preparation, equipment handling, and basic diagnostics.

Entry-Level and Support
Research Assistant / Intern (B.Sc. in view or completed, 0–2 years)
- Assists in experiments, documentation, literature review, and general laboratory duties.

Janitor (O'Level: WAEC/NECO)
- Maintains cleanliness, assists in waste disposal, and enables hygiene compliance.

Staff Shortages and Retention Issues
Workforce shortages and retention problems are the most long-standing challenges in international laboratory human resource management (Dovlo, 2005; Perrone *et al.,* 2024). They are worst in low- and middle-income countries (LMICs), whose finite health care budgets, training infrastructure constraints, and weak policy application contribute to human resource deficits. Even in high-income countries, the laboratory workforce situation is increasingly exacerbated by aging populations, workload intensification, and skills mismatch due to technological innovations. Worldwide, laboratory staffing shortages are the product of various interconnected factors. Report from (Daneault *et al.,* 2025) detailed the human resource challenges faced during ten years of growth in a U.S.-based cell therapy laboratory in an academic setting. The research discovered that as service demands doubled, the recruitment and induction of adequately trained personnel lagged considerably because of limited numbers of qualified personnel and competition from commercial diagnostic laboratories.

Moreover, early career exits and burnout were common due to emotional exhaustion and perceived lack of opportunities for growth (Daneault *et al.,* 2025; Lu *et al.,* 2016). Europe has suffered the same fate, where automation and artificial intelligence created job obsolescence fears, keeping young professionals away from classical laboratory science careers (Nam & Park, 2025; Willcocks, 2020). In Nigeria, the manpower shortage is even more profound and entrenched. Government and tertiary laboratories habitually operate with extreme shortages of manpower, and most units are staffed

at less than 50% of the needed manpower. The causes are many: poor remuneration, absence of professional appreciation, limited career advancement opportunities, and egregiously long government recruitment and posting delays of medical laboratory scientists (Daneault *et al.,* 2025; Lu *et al.,* 2016).
(Olówósejéjé, 2020; Opeyemi *et al.,* 2024) explain that Nigerian laboratory staff are not just overburdened but tend to do so under outdated facilities, shortage of consumables, and erratic power supply—elements which also reduce morale and heighten turnover. Besides, emigration of medical laboratory professionals, commonly termed "brain drain," still weakens Nigeria's laboratory services. Trained laboratory scientists persistently pursue more lucrative and professionally fulfilling jobs overseas, most notably in Canada, the UK, and the Gulf states (Howard *et al.,* 2019). The trend of emigration develops a self-perpetuating cycle in which experienced personnel leave, exerting workload pressure on those who remain, which, in effect, boosts burnout and further resignations.
The scarcity also compromises mentorship lines, with early-career professionals lacking adequate training or supervision, which influences the quality of services and safety standards (Howard *et al.,* 2019). Workforce shortages have been addressed with variable success by recruitment drives. Task-shifting, in which non-laboratory personnel have been trained in performing basic laboratory procedures, has been a response in parts of the Nigerian states. Although this has improved coverage in underserved and rural areas, it is concerning for biosafety practice and the reliability of diagnostics. CPD, residency training, and retention allowances have had partial success worldwide in reducing attrition. However, as (Daneault *et al.,* 2025; Kajumbula *et al.,* 2024) stressed, retention works best when combined with nurturing leadership, career development that can be felt, and reward systems for employees.

Integration of Automation and Technology
The use of automation and digital technologies in laboratory activities has transformed the practice of diagnostics, research, and quality control. Automation is now applied in everything from high-throughput analyzers, Laboratory Information Management Systems (LIMS), and Artificial Intelligence (AI)-assisted diagnostics(Alamer *et al.,* 2024; Naugler & and Church, 2019). Yet this digitalization creates grave personnel management concerns that the laboratories must address in order to remain operational, ethical, and safe. In industrialized nations, total laboratory automation (TLA) has sparked revolutionary transformations in the world of work. According to Nam and Park (2025), contemporary laboratories in nations such as South Korea and Germany have integrated robotics and artificial intelligence in sample processing control, inventory management, and data analysis.
Though these developments have fostered enhanced efficiency and lowered operational expense, they have also given rise to concerns for job displacement, obsolescence of conventional skills, and psychological effect of human–machine interface. For example, laboratory technicians who once performed pipetting, centrifugation, and microscopy are now being called upon to monitor, calibrate, and troubleshoot complex computerized systems tasks which call for a hybrid skill set of biomedical knowledge and IT proficiency (Naugler & and Church, 2019). These shifting expectations call for constant upskilling, reskilling, and technical retraining, sometimes at considerable cost to the organization. Coupled with resistance from older employees, technology unemployment fears, and absence of standard coordinated training programs, they pose obstacles to seamless adoption of automated business processes (Nam & Park, 2025).

To remedy these problems, most institutions have taken strategic human resource initiatives, such as gradual automation, hybrid training programs, and rotation of workers through automated and manual stations to preserve engagement and skill flexibility (Naugler & and Church, 2019). Automation of laboratory practice in Nigeria is low but is slowly picking up, particularly in urban tertiary health facilities and private diagnostic laboratories(Nam & Park, 2025). The use of technology like LIMS, automated hematology analyzers, and digital microscopy is advancing; however, such systems usually run below optimal capacity owing to sporadic electricity, poor IT support, and inadequate staff training (Daneault *et al.,* 2025).

As compared to high-income contexts, automation in Nigeria is often project-based and donor-dependent, which calls into question long-term viability and local ownership. A grave concern lies in the inconsistency between the provision of automation and the ability of staff to run and maintain it properly. According to (Etukudoh *et al.,* 2024), laboratory personnel in Nigeria are generally given little training on automated systems, leading to high breakdown rates, misuse, and underuse of systems. In addition, the absence of vendor support, lack of calibration routines, and lack of user manuals, particularly those not adapted to regional environments, enhance these concerns.

Globally, successful automation in laboratory settings is not simply an issue of machine procurement; it entails strategic alignment of technology, personnel competencies, and institutional goals (Etukudoh *et al.,* 2024). In Nigeria, policy on integration is urgently required to ensure inclusive digital literacy, vendor accountability, and government-funded training for laboratory personnel. In health sector digitalization, policymakers must also deal with cybersecurity, data integrity, and ethical considerations pertaining to AI application in diagnostic decision-making (Nam & Park, 2025).
As great as automation is, it also carries risks if not trailed by deliberate personnel management. Laboratory automation in Nigeria or Germany can only be sustainable if it is underpinned by an active investment in human capacity, change management in organizations, and infrastructural resilience.

Professional Training and Development
Training and professional development (PD) are core pillars of laboratory human resource management with direct effects on performance, safety, quality of diagnostic services, and possible innovation. As laboratory science remains a rapidly changing field in terms of complexity especially with the advent of automation, molecular diagnostics, and artificial intelligence the imperative for periodic upskilling becomes even more essential. Yet most laboratories, particularly in developing nations such as Nigeria, cannot formulate effective training programs aimed at building future competencies and industry demands. Worldwide, laboratory workforce training systems are moving away from inflexible certification models and toward flexible, continuing professional development (CPD) systems (Negussie *et al.,* 2024). CPD focuses on lifelong learning, workshops with hands-on training, e-modules, and scenario-based training to familiarize laboratory personnel with future technologies, quality assurance procedures, and biosafety practices.
Nam and Park (2025) suggest that laboratories that implemented CPD alongside automation experience more incremental change, reduced technical errors, and better job satisfaction for staff. Furthermore, interactive technology like simulation labs and virtual reality (VR) is being utilized across Europe and North America for training staff in new or dangerous laboratory situations, without exposing trainees to actual danger (Aldrich & Anthamatten, 2025; Norris *et al.,* 2019). Such an approach operates to reduce potential risks to laboratory workers. However, in Nigeria and across most of sub-Saharan Africa, training opportunities are ad hoc, under-funded, and detached from laboratory accreditation objectives. The 2025 study by (Shikuku *et al.,* 2024) found that Nigerian laboratory practitioners identified limited access to up-to-date training facilities, few well-structured CPD courses, and the lack of guidance from experienced colleagues as significant obstacles to their professional development.

Furthermore, training syllabi in most institutions are yet to be revised to cover modern diagnostic equipment like PCR-based assays, bioinformatics software, and computerized pathology systems creating a large skills gap between training outputs and market needs. Additionally, Nigerian rural and public health laboratories are even less served. In-house training or sponsorship to participate in professional meetings may be provided in private and city laboratory environments, but most government laboratories depend on ad hoc workshops convened by donor agencies or NGOs (Abdourahamane Yacouba *et al.,* 2020). This promotes disparities in competency levels throughout the nation and undermines national laboratory networks, particularly during public health crises when procedures must be standardized and evolve rapidly (Peter *et al.,* 2016)

Mentorship is yet another untapped strategy for laboratory human resource development. Elsewhere, formal mentorship programs have been demonstrated to improve knowledge retention, instill professional ethics, and facilitate succession planning in laboratory settings (Nam & Park, 2025). In Nigeria, on the other hand, mentorship is largely informal and ad hoc, and early-career scientists get inadequate guidance and feedback on performance. To bridge the gap, Nigeria's education and health national policies must integrate CPD requirements into license renewal, public-private partnerships for training, and investments in e-learning platforms offering modular, accessible, and up-to-date materials. Moreover, partnerships with global laboratory networks can ensure access to top-of-the-line resources and facilitate knowledge sharing (Naidoo & Ihekweazu, 2020). It is worthy to note that training and professional development are not an add-on to laboratory practice they represent key strategic investments underpinning the reliability, adaptability, and global competitiveness of laboratory systems.

Leadership and Communication Gaps
Communication and leadership are also core values in successful laboratory people management. Inadequate leadership and communication breakdown can lead to workflow coordination breakdown, decrease staff morale, promote conflict,

and ultimately undermine diagnostic quality and safety (Mbah *et al.,* 2014). Leadership in high-performing laboratories goes beyond administrative guidance it is about mentoring, encouraging open communications, involving staff in decision-making, and developing a culture of accountability.

But data from low- and high-income nations reveal that most laboratories are afflicted with a deficiency of leadership and an ineffective communication framework, particularly in settings where hierarchical power overshadows interactive participation. Inadequate communication has, on a global scale, been associated with higher laboratory error rates and ineffective team coordination. Nam and Park (2025) argue that the introduction of automation and AI systems in laboratories has further served to pose a challenge for the managers who now must communicate not just in multidisciplinary teams, but also in hybrid environments demanding technical expertise.

When laboratory managers cannot translate complicated technological change into comprehensible operating expectations, employees disengage, are confused, or resist. Likewise, (Mbah *et al.,* 2014) noted that leadership breakdown during rapid lab growth created role ambiguity and staff morale depletion, particularly when management did not bother to define jobs clearly or engage workers in designing workflows. Even worse is the situation in Nigeria. Chronic lack of leadership development, politicization of appointments, and autocratic leadership styles tend to make laboratory personnel feel undervalued and not part of institutional decision-making. Hamel et al. (2015) added that in Nigerian laboratories in certain instances, poor antimicrobial stewardship outcomes were recorded due to poor staff-management communication, where employees were uncertain about protocols or did not feel empowered to provide feedback.

This kind of leadership gap also weakens staff morale, reduces compliance with safety procedures, and promotes an organizational culture where finger-pointing is rampant in situations of audits or errors. Further, Nigerian laboratory hierarchical communication models restrict upward feedback and teamwork. Kerosuo *et al.,* (2010) reported that junior staff in public hospital laboratories feel that they are isolated from administrative management, with few channels through which they can report issues or propose innovations. Such vertical communication gaps prevent the early detection of operational logjams and discourage learning. Additionally, the lack of well-defined communication pathways becomes paramount in public health crises like outbreaks of Lassa fever or COVID-19 where rapid diagnostic coordination is a necessity. This kind of leadership coordination is a necessity.

Worldwide, labs with participative leadership styles where workers are engaged in decision-making and are regularly fed back have better performance levels. Morris, (2023) state that a quality improvement project in a lab for COVID-19 pandemic times resulted in 100% diagnostic effectiveness when communication was enhanced through daily debriefing, team huddles, and active frontline staff engagement in workflow analysis. The interventions not only enhanced service delivery but also team unity and job satisfaction.

Furthermore, good leadership entails emotional intelligence, conflict management, and mentoring of staff. However, in most Nigerian laboratories, the leadership positions are awarded based on seniority or administrative expediency, with little consideration of people skills or formal leadership training ((Ifeoma *et al.,* 2015; McCauley, 2017). The result is sporadic staff management, disproportionate task assignment, and poisonous work environments. In order to enhance laboratory leadership and communication, several strategies are suggested. First, laboratory leadership training should be included in CPD regulations by national training institutes, based on South Africa and UK models. Second, electronic dashboards, internal communications software (e.g., Slack, Microsoft Teams), and formal meeting schedules should be implemented to ensure transparency and instant feedback (Ifeoma *et al.,* 2015).

Thirdly, performance-based metrics must incorporate leadership competency measures for managerial positions so that managers are not only technically sound but also able to manage various, multidisciplinary teams. The closure of leadership and communications gaps is key to the improvement of laboratory performance, staff retention, and consistency in diagnosis. By fostering inclusive leadership and internal communications systems, laboratories working in the developed and developing world are able to build solid, responsive, and dedicated workforces.

Policy and Regulatory Issues

Policy and regulatory frameworks are at the heart of laboratory quality, safety, and accountability. They determine the qualifications of personnel, standard operating procedures (SOPs), biosafety protocols, and accreditation systems. Fragmented or improperly implemented rules, bureaucratic delays, and non-enforcement also often create gaps in laboratory personnel management. Globally and in Nigeria, policy challenges are significant barriers to the creation of an ethical, resilient, and professionally qualified laboratory workforce.

Worldwide, effective policy frameworks are generally characterized by meticulous laboratory staff certification protocols, mandatory continuous professional development (CPD), and organizational commitment to quality management systems. For instance, European Union countries are guided by stringent accreditation systems such as ISO 15189 that require laboratories to demonstrate competency in employee training, documentation, and quality assurance (Nam & Park, 2025). They also enhance staff development with the linkage of license renewal to signed CPD attendance. Besides, national health organizations are known to audit periodically in order to ensure that staff are adequately trained and systems in place are properly maintained (Morris, 2023).

However, even in places that are well-regulated, the practice can differ. As Vasu et al. (2025) opined, regulatory burnout for laboratory workers in U.S. cell therapy laboratories was caused by excessive paperwork, redundant reporting requirements, and drift between clinical practice and regulatory requirements.

These problems are best addressed by regulatory systems that are not just rigorous but realistic, responsive, and created with input from front-line laboratory personnel. Policy and regulatory loopholes are more profound and structural in Nigeria. Even though the Medical Laboratory Science Council of Nigeria (MLSCN) is the national regulator with the responsibility of licensure, accreditation of laboratories, and the enforcement of professional standards, its capacity is typically overburdened. As Opeyemi *et al.,* (2024) observe, laboratories in Nigeria are not comprehensively accredited, and regulation is patchily distributed across public and private sectors. In rural areas, laboratories can be run by non-expert personnel due to shortages and lax regulatory control. Moreover, Nigeria lacks harmonized national policy on laboratories consistent with all-encompassing healthcare reform agendas. There is disease-specific and donor-based policy such as policies relating to HIV, tuberculosis, or malaria resulting in fragmentation and duplication of efforts (Kerosuo *et al.,* 2010). This siloed process inhibits the development of standardized national training programs, workforce planning through coordination, and harmonized quality assurance frameworks. A further related problem is politicization and centralization of the regulatory process. Political loyalty rather than merit is at times employed in appointment to key regulating roles, limiting institutional performance (Ifeoma *et al.,* 2015). Additionally, bureaucratic tape delays registration of new professionals and license renewal, further demoralizing the workers and increasing levels of attrition.

To surmount these challenges, Nigeria must prioritize the creation of an effective national laboratory policy that centralizes people management, infrastructure building, and quality control into one framework. Rwanda and South Africa are worth learning from, where laboratory networks are central but implemented decentralized, allowing for decentralized response to local needs while maintaining national standards. In addition to this, collaboration among health ministries, professional councils, and training institutions can promote regulatory coherence and reduce redundancy. Briefly, establishing robust policy and regulation frameworks is paramount to effective laboratory staff management. Without enforceable, well-defined, and context-relevant regulations, laboratories cannot provide consistent quality staffing, maintain ethical practice, or respond appropriately to public health emergencies. Reform of the regulatory infrastructure, therefore, must be a cornerstone to any national strategy to enhance laboratory systems.

This comparison table of contrasts is employed to contrast Nigerian and Global (International) contexts based on the most prominent themes discussed so far:

Table 1: Nigerian and Global (International) contexts based on the most prominent themes discussed

Theme	Nigerian Context	Global Context
Staffing & Retention	High attrition due to poor pay, brain drain, and weak HR planning (Ifeoma *et al.,* 2015)	Shortages exist but are mitigated by HR modeling, structured recruitment, and retention incentives (Vasu *et al.,* 2025)
Automation & Technology	Limited integration due to funding and training gaps; donor-driven projects often unsustained (Ifeoma *et al.,* 2015)	Widespread adoption of Total Lab Automation (TLA); staff retrained to manage hybrid systems (Nam & Park, 2025)
Training & CPD	Irregular, donor-tied training; minimal digital access; no structured national CPD model (Kerosuo *et al.,* 2010)	Regulated CPD tied to licensure renewal; blended e-learning and skill-based platforms (Nam & Park, 2025)
Leadership & Communication	Top-down, non-participatory styles; poor communication flow and low staff morale (Ifeoma *et al.,* 2015)	Participatory leadership models gaining ground; regular feedback and team debriefs improve cohesion (Morris, 2023)
Regulatory & Policy	Fragmented policies; weak MLSCN enforcement; rural labs often unregulated (Kerosuo *et al.,* 2010)	Standardized frameworks (e.g., ISO 15189); linked to national health strategy and funding (Vasu *et al.,* 2025)

Nigeria shares a lot of the same root causes seen around the globe, but systemic limitations—like weak enforcement, underinvestment in physical infrastructure, and political interference—amplify their impact. International models offer replicable solutions, but these must be adapted to Nigeria's context with long-term investment and policy reform.

Figure 1: Personnel Management in Laboratory Practices: Challenges and Strategies

Strategies for Improvement

Building personnel management in laboratory practice means a comprehensive, systems-oriented approach to address the interrelated issues of workforce shortages, technology shift, training gaps, leadership deficiencies, and lacking regulatory infrastructure. From Nigerian and international evidence, the next section discusses replicable and actionable strategies for developing laboratory workforce management.

Workforce Planning and Retention Incentives

Workforce planning and retention rewards are essential in maintaining laboratory activities. Unbalanced staff levels, inaccurately estimated human resource needs, and high attrition significantly disrupt the delivery of laboratory services, affecting quality and timeliness of diagnostic products. Strategic workforce planning involves the assessment of current and future human resource needs, allocation of available skillsets, and implementation of policies that provide for recruitment, equitable distribution, and retention of skilled laboratory personnel (Makhanya, 2024; Schweyer, 2004) Organized workforce planning models are used in all major high-income countries to align human resources with service delivery goals. The National Health Service (NHS) of the United Kingdom, for instance, hires the services of Health Education England to forecast and plan for health science staff demand based on epidemiologic patterns, population aging-associated demographic shifts, and technological advances (Sparkman, 2025; Vasu *et al.,* 2025). Forecasting models are complemented by centralized data systems and regular reviews enabling proactive changes in staffing and training priorities.

On the other hand, Nigeria's workforce management in laboratories is decentralized, reactive, and underfunded. There is no functioning health workforce registry in the majority of states, which hinders the tracking of attrition, retirement trends, and regional shortages (Kerosuo *et al.,* 2010). Moreover, medical laboratory scientist job postings are typically centralized and bureaucratic, resulting in protracted vacancies in rural regions. This results in uneven workforce distribution—cities may be over-staffed while rural labs face severe shortages.

Retainability is a critical concern too. Nigerian lab professionals always protest poor remunerations, a lack of appreciation, low job mobility, and unattractive work conditions (Ifeoma *et al.,* 2015). They are the forces behind most specialists venturing out to foreign shores for better lives and in return perpetuating today's "brain drain" crisis. More than 3,000 laboratory professionals trained in Nigeria have been incorporated into diagnostic networks in the UK alone within the last five years (Schweyer, 2004; Sparkman, 2025). Such a large brain drain cripples Nigeria's diagnostic capacity and reduces the reserve of experienced mentors to guide the future generation of scientists.

To overcome these challenges, several workforce interventions have been promising. In Rwanda and Ethiopia, for example, task-shifting designs and tiered laboratory structures allow workers to perform tasks based on their levels of training while participating in CPD to move up the professional ladder. Nigeria can adopt similar designs, especially in rural areas, to ensure basic diagnostic capabilities while building local capacity (Shikuku *et al.,* 2024). Incentives are also essential for staff retention. Financial incentives such as rural hardship allowances, housing schemes, and performance-based bonuses have been instituted successfully in countries like Ghana and Kenya (Essuman *et al.,* 2023). Non-monetary incentives like exposure to international exchange, funding for postgraduate courses, and leadership roles also optimize job satisfaction. Vasu et al. (2025) note that career development frameworks and staff development plans are particularly effective when tied to national laboratory policies and harmonized with regulatory authorities. Also, return-of-service contracts may be employed in Nigeria to ensure that healthcare providers who receive subsidized training repay the public health system for a certain minimum number of years. This has been implemented effectively in South Africa, where provincial governments sponsor healthcare professionals subject to post-training deployment in deprived areas (Morris, 2023).

Finally, strategic workforce planning and carefully crafted incentive schemes are critical to the establishment and sustenance of a competent laboratory labor force. For Nigeria, this translates into a paradigm switch from reactive recruitment to evidence-based planning, underpinned by policies that motivate and reward laboratory workers.

Continuous Professional Development (CPD) and Mentorship

Continuous Professional Development (CPD) and institutionalized mentorship are major pillars in long-term sustainable laboratory personnel management. With rapidly evolving laboratory science due to technological progress, emerging pathogens, and evidence-based laboratory diagnostic platforms, laboratory practitioners should keep competences abreast of global demands and national service demands. In such a situation, CPD enables laboratory workers to continuously update their knowledge and skills, while mentorship provides knowledge exchange, emotional support, and professional self-development, particularly for beginner scientists and interns (Shikuku *et al.,* 2024).

Globally, CPD is institutionalized in official regulatory requirements and in most instances is linked to renewal of licensure or certification. For instance, in the UK and Canada, medical laboratory technologists are required to document

CPD hours every year that can include accredited workshops, online education, peer-reviewed journals, or skill-based simulation (Sparkman, 2025). From Nam and Park (2025), South Korean laboratories have incorporated digital CPD platforms based on augmented reality (AR) and artificial intelligence (AI)-enabled e-learning to improve real-time reinforcement of skills, especially for automation equipment and biosafety protocols.

Mentorship is also a very important aspect in high-income countries where junior staff are incorporated into multidisciplinary working teams under the supervision of experienced laboratory technologists. This kind of setup guarantees technical proficiency alongside critical thinking, error avoidance, and ethical practice in the lab (Morris, 2025). Effective mentorship schemes are likely to be institutionalized with defined objectives, evaluation criteria, and institutional support.

CPD is also lopsided in Nigeria. CPD is mandatory in re-licensing by the Medical Laboratory Science Council of Nigeria (MLSCN); nevertheless, participation rates are inconsistent, especially in government laboratories and in rural areas where internet access, training resources, and transport are major hindrances (Kerosuo *et al.,* 2010). Most of the CPD is donor-funded and targeted at specific disease programs, i.e., HIV or tuberculosis, thus limiting their usability and sustainability (Ifeoma *et al.,* 2015). Furthermore, most CPD activities in Nigeria remain highly theoretical with few demonstrations or practice exercises. Employees are generally not able to translate learning concepts into everyday practice due to equipment limitations or lack of follow-up. In-service training is also rarely focused on actual employee performance gaps or institutional priorities. This mismatch is also promoted by the absence of mentorship structures in laboratories. Younger staff members commonly complain of insufficient support from their senior colleagues and limited access to peer mentors or role models (Kerosuo *et al.,* 2010).

To increase CPD and mentoring effectiveness in Nigeria, the following steps are achievable. Decentralized centers for CPD must be established in every state, possibly through teaching hospitals, to provide routine and site-specific training. These can extend to modular training in automation, molecular diagnostics, data management, and biosafety, particularly to equipment available in local facilities. National e-learning platforms facilitated through MLSCN can improve distant access for remote staff. Local languages and mobile technology can extend reach and impact even more (Ngenzi *et al.,* 2021).

In terms of mentorship, the Nigerian labs may implement formal peer mentorship programs, under which each junior personnel is linked with a senior technologist. Such a framework worked in India and South Africa too, wherein staff turnover declined and SOP adherence was improved (Vasu *et al.,* 2025; Norris *et al.,* 2019)). Mentors participation has to be recognized with merit awards and considered for performance appraisal also. CPD and mentorship are essential pillars in developing an effective, spirited, and future-oriented laboratory workforce. Such processes must be institutionalized in Nigeria—through policy connection, funding, and technology innovation—so as to enhance significantly personnel capacity, morale, and laboratory quality overall.

Inclusive and Participatory Leadership

Laboratory leadership is far greater than supervision and delegation; it encompasses communication, empowerment, decision-making, conflict resolution, and motivating a common vision. Inclusive and participatory leadership has emerged to be widely valued as a primary tactic to enhance employee morale, productivity, and foster accountable and collaborative culture in laboratories (McCauley, 2017).

In participatory leadership models, the employees are asked to join in ideas, give feedback, and share in decision-making. Participatory environment facilitates ownership of the work, clear expectations, and shared accountability. Nam and Park (2025) further note that laboratories that adopted participatory models in South Korea had smoother deployment of the automation systems, as workers felt invested and properly prepared for the transition. These tables also reduce resistance to change and improve performance by the use of the diverse experience and perspective of staff from employees from different departments. Leadership in most Nigerian laboratories, however, remains comparatively hierarchical and centralized. Decisions are normally made with no consultation of mid- or junior-grade employees, and information flows top-down. (Morris, 2023) observed that the autocratic style engenders disengagement, poor morale among employees, and non-adherence to standard operating procedures (SOPs), especially in policy implementation. Lab scientists commonly complain they are not consulted in workflow redesign or in purchasing equipment, leading to incompatible equipment and operational inefficiencies.

The greatest problem in Nigeria is appointing laboratory managers on administrative or seniority basis rather than leadership potential. (Kasvosve *et al.,* 2014) observe that leadership roles are appointed without leadership training, and thus numerous managers are not proficient in addressing staff development, team performance, or conflict. This generates bad working conditions, bad staff retention, and ineffective laboratory processes.

To transition towards participatory leadership, certain steps are recommended. Leadership development must first be institutionalized in CPD programs and linked to career progression.

The training must focus on communication skills, emotional intelligence, and human resource management in health facilities. (Sparkman, 2025) suggests incorporating mentorship, 360-degree feedback, and peer coaching into leadership development models to foster inclusive thinking and collaborative behavior.

Second, laboratories must develop internal policies that promote shared governance. Examples include frequent team huddles, suggestion boxes, monthly lab meetings, and systematized feedback mechanisms that allow frontline workers to voice concerns and work together to address them. Morris, (2023) demonstrated that involving laboratory personnel in workflow optimization to address the COVID-19 pandemic in the UK led to improved diagnostic efficiency and decreased errors.

Third, lab director performance reviews must include metrics of staff morale, communication, and worker satisfaction beyond technical or administrative output. This shift in standards of evaluation promotes open practice and holds leaders accountable for sustaining positive workplace cultures (Nam & Park, 2025; Sparkman, 2025). Inclusive, participatory lab leadership promotes operational excellence by aligning team effort, motivation, and change adaptability. Possibly more than in any other country, this transition from the hierarchical, non-consultative model to the collaborative model will require conscious reforms in training, organizational policy, and professional culture in Nigeria.

Automation-Ready Workforce Development

The increasing role of automation in laboratory procedures offers unprecedented potential to improve diagnostic accuracy, accelerate turnaround time, and increase throughput. Such change comes with a fundamental requirement, however, for a workforce that is technically capable as well as digitally literate and adept at managing, maintaining, and interpreting data generated by automated instruments. Becoming "automation-ready" is hence a strategic imperative for laboratory staff management across healthcare settings (Etukudoh *et al.,* 2024).

In industrialized countries, employee development programs for laboratories increasingly emphasize hybrid skills classic wet-lab practices are supplemented by the ability to do data science, system problem-solving, and health informatics. According to Nam and Park (2025), South Korean Total Laboratory Automation (TLA) labs found that re-tooling the employees into system monitors rather than hand testers significantly improved laboratory performance. The re-tooling included certification in computer-based LIMS platforms, competency-based assessments, and machine-interface simulations (Etukudoh *et al.,* 2024). Similarly, in America, advanced laboratories employed a double-track training system made up of operational and IT modules to equip workers to handle real-time data amalgamation, artificial intelligence-based workflows, and automated reminders-based quality control (Vasu *et al.,* 2025). This has minimized diagnostic errors, enhanced traceability, and allowed easier compliance with regulations through audit-proof electronic documents (Nam & Park, 2025).

On the contrary, Nigerian laboratories, especially within the public health sector and rural setup, are drastically hampered from developing an automation-capable manpower. While some urban and private laboratories have adopted semi-automated equipment such as automated hematology analyzers or PCR platforms, the majority of installations lie dormant due to the lack of qualified personnel and the poor vendor support (Ifeoma *et al.,* 2015). One of the issues commonly cited is that hardware provided by global health partners typically comes without proper training, local language manuals, or viable maintenance agreements. The shortage of skills is also supplemented by the absence of Medical Laboratory Science (MLS) course curriculum reforms in Nigerian universities and colleges. The curricula are more manual-based with minimal exposure to computer tools or the principles of automation. Siamalube and Ehinmitan (2025) point out that in the absence of deliberate reform, graduates do not possess the ability to operate modern diagnostic settings properly, leading to inefficiencies in operations and low confidence among staff.

To address such challenges, Nigeria must adopt a multi-faceted strategy. Firstly, undergraduate and postgraduate laboratory science curricula must be revamped to include courses in automation, digital pathology, health informatics, and data visualization. Secondly, partnerships with automation suppliers and technology companies can provide modular training modules, certification, and continuous updates as systems evolve. Public–private partnerships can even fund simulation laboratories in teaching hospitals to facilitate practical exposure to automated workflows.

Furthermore, laboratories must establish on-site "train-the-trainer" initiatives where key personnel are comprehensively trained to cascade competencies within their institutions. The models have worked in Uganda and India, where national laboratory networks developed sustainable in-house capacity for GeneXpert and other automated diagnostic management (Kasvosve *et al.,* 2014; Sparkman, 2025). Regulatory body and government must insist on automation literacy as a prerequisite for licensure and CPD. Incorporating automation-readiness into national laboratory policy ensures that technological investment is allied with investment in people, creating a strong, proofed-for-the-future workforce (Ngenzi *et al.,* 2021).

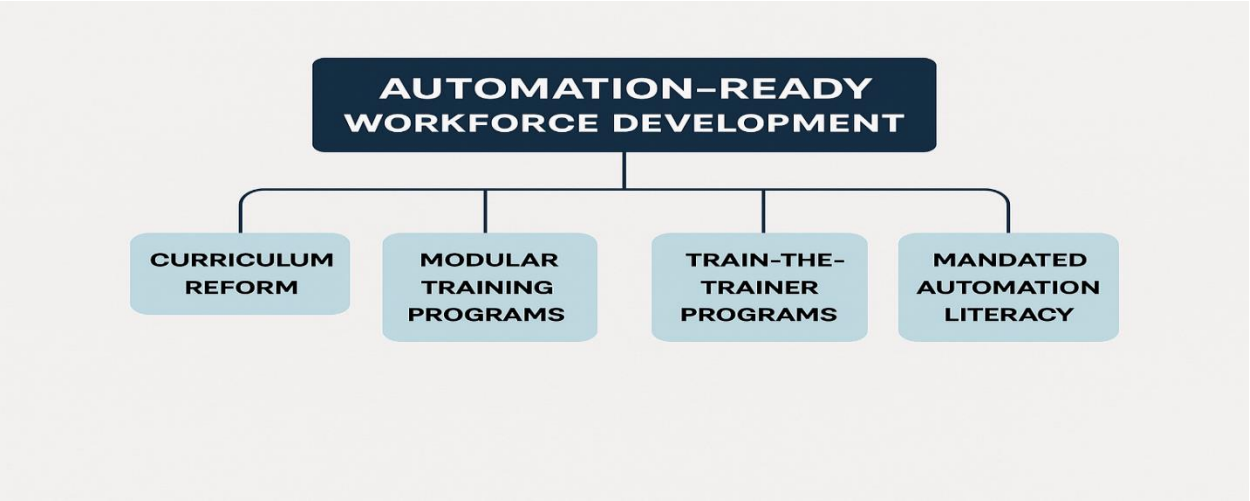


Figure 2: Organogram of an Automation Ready Workforce Development

Enforced Regulatory and Policy Frameworks

Strong policy and regulatory frameworks are required for effective personnel management in laboratory systems. These frameworks provide the framework for workforce competence, training, licensure, and institutional accreditation. In case policies are not effective or sound, laboratory systems suffer from variable quality of service, unqualified workers, and inability to maintain international standards. Strengthening regulatory systems is thus a cornerstone of improved laboratory workforce performance and accountability, especially in low- and middle-income economies like Nigeria. Globally, countries with effective laboratory governance systems are marked by consistent performance through well-defined legislation connecting professional licensure to continuous education and facility accreditation. In Canada and the European Union, laboratories are regulated under the ISO 15189 standards, which mandate complete documentation of personnel qualifications, ongoing competence assessments, and periodic external audit (Nam & Park, 2025). These systems are incorporated into national health systems and typically supported by specialized laboratory regulatory bodies charged with overseeing both the private and public institutions.

In Nigeria, the regulatory environment for laboratory services is fragmented and under-funded. While the Medical Laboratory Science Council of Nigeria (MLSCN) is the regulatory body with statutory power to oversee the profession, it faces significant operational and structural problems. The majority of Nigerian laboratories function below full accreditation or with unacceptable standard operating procedures (SOPs), especially in the rural and private health systems, according to Morris (2025). Regulatory activities are mostly limited to tertiary institutions as well as donor schemes, and an enormous majority of diagnostic centers lack regulation and are under-exposed to suboptimal staffing practices. Facilitating this issue is the absence of a uniform national laboratory policy. Instead, there is patchwork regulation driven by disease-specific vertical programs (e.g., HIV, TB, or malaria) funded by international agencies. The

fragmentation causes duplication, wastage, and missed opportunities to institutionalize training, quality assurance, and staff planning (Kerosuo *et al.,* 2010). Further, regulatory compliance is hindered by political interference in key appointments and underfunding of licensing and inspection departments.

To achieve this, Nigeria must establish a national National Laboratory Policy (NLP) that will be harmonized with the national health policy and human resource strategy. The policy should be an integrating framework that includes recruitment standards, training, task allocation, professional development, and ethics. The policy should also define clearly the functions of MLSCN, the Ministry of Health, institutions of education, and development partners. Apart from that, enforcement of policy must also be decentralized. State-level regulatory committees for laboratories running under MLSCN guidelines can provide more locally responsive regulation. This system, applied in South Africa through provincial laboratory governance frameworks, has increased compliance and responsiveness to local health needs (Kasvosve *et al.,* 2014; Shikuku *et al.,* 2024; Sparkman, 2025).

Digitalization of the regulatory process is also important. A web-based register of authorized laboratory professionals with corresponding biometric information and CPD records will enhance transparency and responsibility. The laboratory audits should also be standardized and performed on a routine basis using risk management methods. Regulatory and policy transformation in Nigeria must be led by enforcement, professional accountability, and alignment with global best practices. A functional, effective, and well-funded regulatory system is essential for protecting public health, assuring diagnostic quality, and improving the country's laboratory workforce.

Inter-Institutional Collaboration and Global Partnerships

Inter-institutional collaboration both local and global has emerged as the key approach to addressing the problems of the workforce within laboratory systems. Inter-institutional collaboration involves institutions' collaboration such as universities, teaching hospitals, research centers, the regulatory bodies, and the private laboratories; while international collaboration involves international agency partnerships, academic consortia partnerships, and donor agency partnerships. Taken together, the collaborations speed up workforce development, improve quality practices, and enhance training and research capacity especially in resource-limited countries like Nigeria.

In the majority of developed countries, inter-laboratory networks are common. For example, Germany's university medical centers have close relationships with public health laboratories and biotech companies, so mutual training, equipment access, and collaborative research become more convenient (Nam & Park, 2025). Not only do these networks exchange loads of resources, but they also support laboratory professionals' diverse learning environments. Similarly, state public health laboratories in the United States are supported by establishments like the Centers for Disease Control and Prevention (CDC) through fellowships in workforce, collaborative training programs, and coordination in outbreak responses (Vasu *et al.,* 2025; Morris, 2023).

In Nigeria, however, institutional silos prevail. Laboratory schools, teaching hospitals, and diagnostic facilities operate in isolation, forfeiting the opportunity to pool resources or coordinate workforce training. Therefore, early-career laboratory scientists graduate without adequate experience in actual automation, molecular diagnostics, or research methodology (Ifeoma *et al.,* 2015). In addition, teaching curricula are scarcely referenced to skills needed in public health laboratories, which results in skill mismatches.

In order to address these issues, creating systematic collaboration between universities and diagnostic facilities can facilitate experiential, skill-based learning. Such as, inter-institutional CPD courses, transfer of internships, and co-supervised student research studies can establish a greater interface between academic and practice environments. Another such model is the creation of regional laboratory training centers where multiple institutions collectively conduct learning programs. These hubs have been successful in Kenya and Ethiopia, where WHO and the African Society for Laboratory Medicine (ASLM) have supported integrated training centers for building workforce capacity (Kajumbula *et al.,* 2024). Global collaborative partnerships have also played a key role in supporting laboratory workforce development, particularly in sub-Saharan Africa. Donor-funded programs such as PEPFAR, the Global Fund, and CDC Global Health Security Agenda have all made significant contributions toward staff capacity building, lab infrastructures, and accreditation processes. (bosonkie *et al.,* 2023) clarify, global cooperation has enabled Nigerian labs to roll out HIV viral load testing, GeneXpert TB testing, and COVID-19 molecular surveillance initiatives which would otherwise be out of reach because of cost and technical constraints.

However, the long-term sustainability of such collaborations is typically in question. When donor funds run dry, the majority of programs collapse because they lack local ownership, government support is poor, or programs are not mainstreamed into national plans. International collaborations should thus concentrate on capacity transfer and be aligned with country-led health worker strategies to ensure continuity. Nigeria's National Laboratory Strategic Plan should therefore consolidate global collaborations under a framework for governance that concentrates on building skills, sharing information, and long-term sustainability.

The inter-institutional efforts and global partnerships hold promise to strengthen, retain, and equip laboratory personnel by integrating local training institutions, coordinating learning currents, and accessing international experience, Nigeria and others are able to establish laboratory systems that are robust, responsive, and future-resistant.

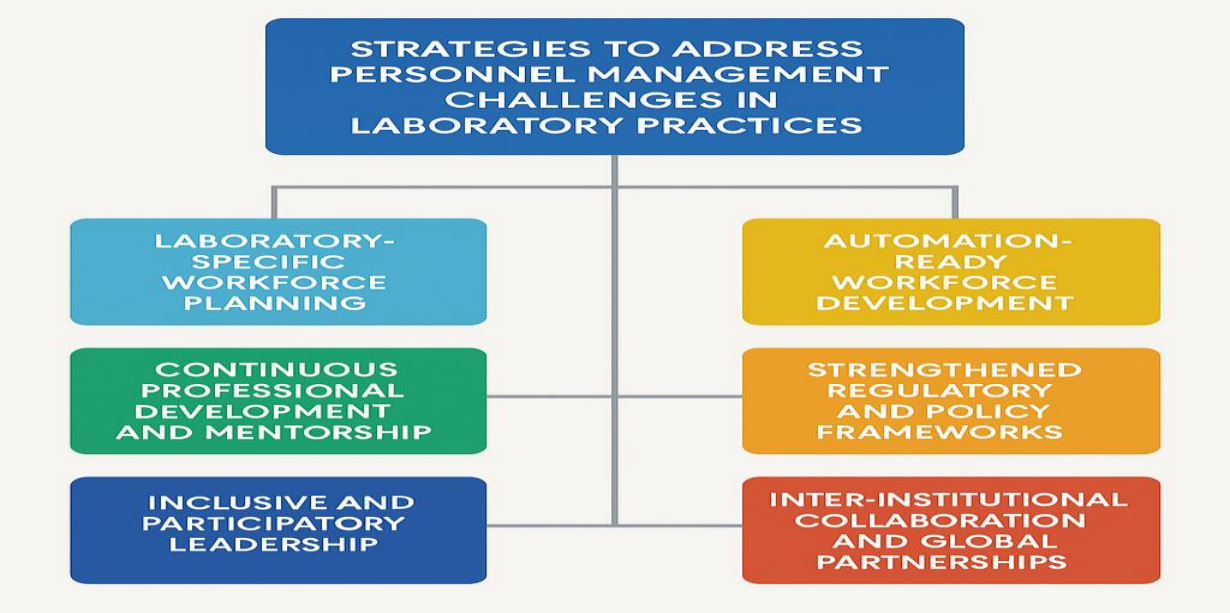


Figure 3: Summary infographic of all strategies to address Personnel Challenges

CONCLUSION

This paper examines the challenges faced by laboratory managers in Nigeria and other countries, focusing on staff management, safety, and service quality. The challenges include shortages of personnel, automation-induced displacement, ineffective leadership, inadequate training, and decentralized regulatory schemes. These issues affect the quality and reliability of diagnostic services, potentially harming public health outcomes. The paper highlights the importance of policy coordination, funding, and governance in impacting workforce performance. Unlike foreign laboratories, Nigerian laboratories face underfunding, policy chaos, and weak strategic planning. Structural issues like poor inter-agency coordination, donor-driven interventions, and the emigration of qualified professionals abroad exacerbate these disparities. The report suggests actionable plans to enhance laboratory workforce management, such as data-driven workforce planning, institutionalization of continuous professional development (CPD) and mentorship programs, inclusive leadership styles, and automation-capable training tracks. It also calls for intensifying regulatory control and integrating laboratory staff management into national health plans.

In Nigeria, the success of any lab system depends on the people who operate it. Investing in building, supporting, and regulating laboratory personnel is not just a professional obligation but a public health necessity. A strong, effective, and well-governed laboratory workforce is the foundation for achieving universal health coverage, outbreak preparedness, and diagnostic excellence in any health system.

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