ISSN 1998 – 409X

REVIEW ARTICLE

Medical Laboratories in Healthcare Delivery: Roles, Impact, Challenges, and Future Directions

Shivkant Patel[1], Harshkumar Brahmbhatt[2]*, Mahavir M. Sharma[3], Dhruvi R Shah[4]

[1]Department of Pharmacy, Sumandeep Vidyapeeth Deemed to be University, Piparia, Vadodara, Gujarat, India, [2]Department of Quality Assurance and Analysis, Sardar Patel College of Pharmacy, Bakrol, Anand, Gujarat, India, [3]Department of Pharmacy, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India, [4]Department of Pharmaceutics,Parul college of Pharmacy and Research, Parul University-Ahmedabad, Gujarat, India

Abstract

Medical laboratories are essential to healthcare delivery because they support diagnosis, monitoring, prognosis, treatment selection, and public health surveillance. This review examines the central roles of medical laboratories in clinical care and health system performance, with particular attention to low- and middle-income countries (LMICs), where limited infrastructure, workforce shortages, and weak diagnostic networks often delay care and reduce treatment quality. The review also highlights the importance of laboratories during pandemics, especially COVID-19, when testing and surveillance became critical for case detection, outbreak control, and patient management. Beyond traditional functions, laboratory medicine is increasingly shaped by automation, molecular diagnostics, digital systems, and artificial intelligence, which can improve speed, accuracy, and scalability when supported by strong governance, quality systems, and staff training. The findings show that laboratory services are not peripheral technical units but strategic health assets that influence individual outcomes, population health, and health system resilience. However, their impact is constrained by poor access, fragmented networks, insufficient funding, and inconsistent quality management, particularly in LMICs. Strengthening laboratory infrastructure, workforce capacity, and quality assurance systems is therefore necessary to improve healthcare delivery and emergency preparedness. This review concludes that medical laboratories must be integrated more fully into health policy and clinical decision-making if health systems are to achieve timely, equitable, and effective care.

Key words: Artificial intelligence, diagnostics, healthcare delivery, laboratory medicine, medical laboratories, quality management systems

INTRODUCTION

Medical laboratories are indispensable to healthcare because they generate the evidence used for diagnosis, monitoring, prognosis, and treatment selection. A wide range of clinical decisions depend on laboratory results, including whether a patient has an infection, whether a disease is responding to treatment, whether a malignancy is present, and whether chronic disease is under control. In this sense, laboratory medicine is not a peripheral service but a core clinical function.[1,2]

The importance of laboratories became especially visible during the COVID-19 pandemic. During that period, diagnostic testing, surveillance, and testing coordination became vital for controlling transmission and supporting patient care.[3] The review also shows that laboratory medicine is especially important in low- and middle-income countries (LMICs), where weak infrastructure, limited funding, and shortages of trained staff frequently delay diagnosis and reduce treatment quality. In such settings, a laboratory is often the difference between timely care and missed opportunity.

The field is also changing rapidly. Automation, molecular diagnostics, digital systems, and artificial intelligence (AI) are transforming laboratory practice. These innovations can

Address for correspondence:
Mahavir M. Sharma, Department of Pharmacy, Sumandeep Vidyapeeth Deemed to be University, Vadodara, Gujarat, India. Phone: 9727264003.
E-mail: mahavir.svp@gmail.com

Received: 22-07-2026
Revised: 29-08-2026
Accepted: 08-09-2026

© 2026 Author(s). This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0)

improve speed, accuracy, and scalability, but only if they are supported by appropriate governance, infrastructure, training, and quality systems. As health systems become more data-driven, the role of laboratories will continue to expand rather than shrink. This review therefore examines both the traditional and emerging roles of laboratories in healthcare delivery.[4-6]

SCOPE OF THE REVIEW

This review focuses on the major roles of medical laboratories in healthcare delivery and the challenges that shape their effectiveness. It considers diagnostic services, disease surveillance, pandemic preparedness, quality management, workforce capacity, and the integration of new technologies such as AI. It also highlights the special problems faced by laboratories in LMICs, where limited resources and fragmented systems often prevent full access to diagnostic care.[7-9]

The broader aim is to show that laboratories are not merely technical units. They are strategic health assets that influence individual outcomes, population health, and system resilience. This review also reflects the article's emphasis on integrated laboratory networks, cost-effective quality systems, and collaborative governance.[10] The discussion is organized to show how each of these elements contributes to stronger healthcare delivery.

DIAGNOSTIC FUNCTION

The most basic function of a medical laboratory is diagnosis. Laboratory departments such as microbiology, hematology, biochemistry, immunology, histopathology, cytopathology, blood banking, molecular biology, and cytotechnology all contribute to the detection and classification of disease. Together, these departments make it possible to identify infection, inflammation, malignancy, metabolic disorders, blood diseases, and genetic abnormalities.[11-14]

Laboratory testing supports several stages of clinical care. The source text identifies etiological diagnosis, patient monitoring, and epidemiologic surveillance as three major areas where *in vitro* diagnostics contribute to patient management. Etiological diagnosis identifies the cause of illness; monitoring shows whether treatment is effective; and surveillance tracks disease patterns across communities. These three functions make laboratories essential in both clinical medicine and public health.[15] A pie chart summarizing the various processes in medical laboratories is shown in Figure 1.

This diagnostic role is especially important because symptoms alone are often not enough to guide accurate treatment. Many diseases present similarly, and only laboratory evidence can confirm the true cause. The result is that laboratories

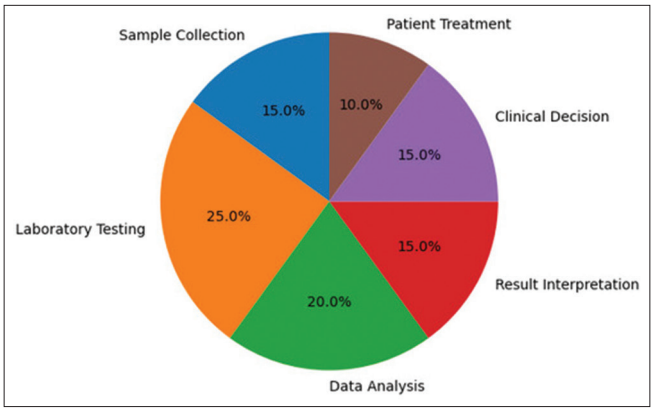


Figure 1: Pie chart summarizing the various processes in medical laboratories

reduce uncertainty and support more precise clinical action. In modern healthcare, diagnosis without laboratory support is often incomplete.Table 1 show Major roles of medical laboratories in healthcare.

CLINICAL DECISION SUPPORT

Laboratories do not only produce data; they enable clinical decisions. Every stage of the laboratory testing process influences how a clinician interprets disease and chooses a treatment plan. The reviewed article describes a pathway that begins with sample collection and moves through testing, data analysis, result interpretation, clinical decision-making, and final treatment. Each step must be carefully managed if the final result is to be clinically useful.[22]

This means that laboratory medicine has both technical and interpretive value. A result is meaningful only when it is accurate, delivered on time, and understood in context. Clinicians rely on laboratory professionals to provide high-quality assays, interpret complex results, and advise on test selection.[23] The article emphasizes that this is particularly important for junior clinicians, who may need guidance in reading results and applying them to treatment decisions.

The collaborative dimension of laboratory medicine is therefore very important. Laboratory professionals can provide interpretive comments, alerts, and consultation that make reports easier to use clinically. This reduces the chance of error, supports evidence-based practice, and improves patient care. A laboratory that is disconnected from clinicians may still generate numbers, but it will not maximize its healthcare value.[24]

ROLE IN PANDEMICS

One of the strongest themes in the source document is the role of laboratories in pandemic preparedness and outbreak response. COVID-19 highlighted how essential laboratory

systems are in identifying infections, confirming cases, and guiding public health action. Early testing helped slow transmission, support isolation strategies, and direct the use of healthcare resources. The pandemic made it clear that laboratories are a frontline defense in health emergencies.[25]

The review also places COVID-19 in a broader historical context that includes SARS, H1N1 influenza, MERS, Ebola, and Zika. These events show that future outbreaks are not hypothetical. They are expected, and health systems must be ready. Strong laboratory networks are therefore not optional infrastructure; they are core emergency preparedness tools.[26]

The article argues that pandemic readiness requires regional coordination, mobile laboratories, validated protocols, and resilient supply chains. It also stresses the importance of communication among government agencies, public health departments, clinicians, industry partners, and laboratory professionals. This kind of multi-sector collaboration improves response speed and reduces fragmentation during crises.[27]

ACCESS IN LMICs[28-33]

The review devotes substantial attention to diagnostic access in LMICs, especially in Africa. In these settings, access is constrained by weak infrastructure, limited funding, shortages of trained personnel, and poor supply chains. As a result, many patients are not tested in time, and some are never tested at all. This creates a serious gap between medical need and service availability.

The consequences are visible across several disease areas. The source text cites poor viral load monitoring among people living with HIV, missed early infant diagnosis, very limited tuberculosis testing, and underdiagnosis of hepatitis B and C. It also notes that fewer than 30% of pregnant women in one West African setting had access to essential antenatal screening tests. These examples show how weak laboratory systems can affect maternal health, infectious diseases, and cancer prevention.

The problem is not only a lack of devices. The article argues that too much diagnostic policy focuses on single sites or disease-specific programs, while broader system needs are neglected. Functional laboratory networks, specimen transport, standardization, workforce development, and supply chain planning are necessary for meaningful access. Without those foundations, even good technologies remain underused.

QUALITY MANAGEMENT

Quality management is a major pillar of effective laboratory medicine. If results are inaccurate or delayed, patient safety suffers. The article therefore emphasizes quality management systems, including the ISO 15189:2022 framework, as a practical model for maintaining competence and reliability. These systems are especially valuable in LMICs because they help laboratories improve performance in a structured and cost-conscious way.[34]

A robust quality management system includes standard operating procedures, calibration and maintenance of equipment, internal quality control, external quality assessment, staff competency review, documentation, audits, corrective actions, and risk management. Each element contributes to consistency and accountability. Taken together, they help ensure that a laboratory can trust its own results and that clinicians can trust the laboratory.

The review argues that quality systems are not a luxury. They are essential to health service delivery and patient safety. In settings where resources are limited, a cost-effective quality model is especially important because it allows laboratories to improve without excessive financial burden. This approach is realistic, scalable, and sustainable.[35]

WORKFORCE AND COLLABORATION[36]

The laboratory workforce is one of the most important determinants of quality. The source document notes that laboratory personnel are often underappreciated, despite their major role in training, testing, validation, and communication. A laboratory can have modern equipment, but without skilled and motivated staff, performance will still be limited. The human element remains central.

The article also stresses the importance of collaboration between laboratory professionals and hospital clinicians. Clinicians help shape the tests that laboratories must provide, while laboratory specialists guide test interpretation and method selection. This collaboration is especially important when clinicians need support in understanding complex or borderline results. Interpretation, traceability, harmonization, and pre-analytical quality all benefit from stronger communication.

Laboratory medicine is therefore a relational discipline as much as a technical one. Its effectiveness depends not just on machines and reagents, but also on trust, communication, and shared responsibility. When laboratories and clinicians work together, diagnostic pathways become faster, more accurate, and more patient-centered.

AI[36,37]

AI is presented in the source text as a transformative opportunity for laboratory medicine. AI can improve image analysis, support predictive analytics, automate repetitive tasks, and enhance decision support. These benefits may

Table 1: Major roles of medical laboratories in healthcare[16-21]

Role	Key functions	Impact	Examples
Diagnostic function	Detection and classification of disease	Reduces clinical uncertainty, enables precise treatment	Microbiology (infections), Hematology (blood diseases), Histopathology (malignancies) pressbooks.bccampus
Clinical decision support	Sample collection→ testing→ interpretation→ treatment	Guides therapy selection, supports evidence-based practice	ETiological diagnosis, patient monitoring, test selection advice for junior clinicians
Pandemic response	Early testing, case confirmation, surveillance	Frontline defense in health emergencies, slows transmission	COVID-19 testing, SARS/H1N1/Ebola outbreak response, mobile laboratory deployment
Surveillance	Tracks disease patterns across communities	Public health planning, outbreak detection	Viral load monitoring (HIV), tuberculosis testing, hepatitis B/C screening
Quality management	ISO 15189:2022 frameworks, SOPs, calibration	Ensures reliable results, patient safety	Internal/external quality control, staff competency reviews, equipment maintenance
Workforce development	Training, validation, communication	Central to quality, even with modern equipment	Skilled staff in testing, interpretation, test selection guidance
AI integration	Image analysis, predictive analytics, automation	Improved efficiency, accuracy, faster answers	Decision support tools, automated repetitive tasks (requires data infrastructure and governance)

help laboratories manage workload, improve accuracy, and provide faster answers to clinicians and patients.

The article is also careful to note the limits of AI adoption. Challenges include limited data availability, weak digital infrastructure, ethical concerns, privacy issues, and potential algorithmic bias. These are serious barriers, especially in LMICs, where digital readiness may lag behind innovation. A successful AI strategy therefore requires more than software. It requires investment in data systems, governance, regulation, and technical capacity.

The broader message is that AI should complement laboratory professionals rather than replace them. Human expertise remains essential for oversight, interpretation, and accountability. AI can strengthen laboratory medicine, but only when it is implemented responsibly and locally adapted.

POLICY IMPLICATIONS[37]

The review carries clear policy implications. First, governments should treat diagnostic systems as essential health infrastructure rather than secondary support services. Second, laboratory networks should be integrated across levels of care so that patients can move through the system without unnecessary delays. Third, quality management should be funded as a core operational need rather than an optional extra.

The article also implies that investment should balance high-tech innovation with basic system strengthening. In many LMICs, the most urgent gains may come not from advanced AI but from better specimen transport, better staffing, better maintenance, and better quality control. Technology will matter, but foundational capacity matters first.

Finally, the review supports stronger collaboration among governments, professional associations, international agencies, and private-sector partners. Health systems are more resilient when laboratory planning is coordinated rather than fragmented. Effective governance, financing, and regulation are necessary to make diagnostic services equitable and sustainable. A summary table of Policy Priorities for Laboratory Strengthening is shown in Table 2.

FUTURE DIRECTIONS

The future of medical laboratories will likely be shaped by digitalization, network integration, and quality-driven innovation. Laboratories that adopt standardized systems and integrate with clinical services will be better positioned to support patient care. Those that invest in digital tools may improve turnaround time, surveillance, and efficiency. Those that strengthen workforce training will be more adaptable to future challenges.

The source file also points to future research needs. These include better metrics for evaluating laboratory impact, clearer assessment of cost-effectiveness, and more study of AI implementation in real-world settings. More evidence is needed on how laboratory networks function across disease areas and how they can be scaled sustainably. Future research should also include more voices from LMICs and regional publishing contexts.

The central message is that laboratory medicine will become more important, not less. As medicine grows more

Table 2: Policy priorities for laboratory strengthening[38]

Priority	Action required	Rationale	LMIC focus
Treat diagnostics as essential infrastructure	Government funding, regulatory support	Core health asset, not secondary service	Foundational capacity first (specimen transport, staffing)
Integrate laboratory networks	Cross-level care integration, referral systems	Patient movement without delays	Network integration over disease-specific programs
Fund quality management	ISO 15189:2022 implementation, audits	Patient safety, reliable results	Cost-effective quality models for limited resources
Balance innovation with basics	AI+workforce+ maintenance+quality control	Technology matters, but foundations matter first	Prioritize staffing, maintenance, transport over advanced AI
Strengthen collaboration	Governments, associations, agencies, private sector	Coordinated planning, resilient systems	Multi-sector communication, shared responsibility

LMIC: Low- and middle-income countries, AI: Artificial intelligence

data-driven, the laboratory will remain the bridge between biological evidence and clinical action. Its future depends on a balance of technology, quality, workforce, and system integration.

CONCLUSION

This review establishes that medical laboratories are indispensable strategic health assets, not peripheral technical units. Laboratories generate the evidence required for diagnosis, monitoring, prognosis, and treatment selection across diverse clinical conditions, including infections, malignancies, and chronic diseases. Their diagnostic function – spanning microbiology, hematology, biochemistry, histopathology, molecular biology, and cytotechnology – enables detection and classification of disease, reducing clinical uncertainty and supporting precise action. Laboratory testing serves three critical areas: Etiological diagnosis (identifying illness causes), patient monitoring (evaluating treatment effectiveness), and epidemiologic surveillance (tracking community disease patterns).

The COVID-19 pandemic vividly demonstrated laboratories' frontline importance for diagnostic testing, surveillance, and coordination, making them essential for controlling transmission and supporting patient care. Historical outbreaks – including SARS, H1N1, MERS, Ebola, and Zika – confirm that future pandemics are expected, not hypothetical, necessitating robust laboratory networks as core emergency preparedness infrastructure. Pandemic readiness requires regional coordination, mobile laboratories, validated protocols, resilient supply chains, and multi-sector communication among governments, public health departments, clinicians, and laboratory professionals.

In LMICs, particularly Africa, diagnostic access remains severely constrained by weak infrastructure, limited funding, trained personnel shortages, and broken supply chains. Many patients face delayed or no testing, creating gaps between medical need and service availability. Consequences include poor viral load monitoring for HIV patients, missed early infant diagnosis, limited tuberculosis testing, hepatitis underdiagnosis, and inadequate antenatal screening for pregnant women. Remedies require system-level investments: Integrated laboratory networks, specimen transport systems, workforce development, standardization, and supply chain planning – not merely additional devices.

Quality management systems, including ISO 15189:2022 frameworks, are essential pillars for maintaining competence and reliability, especially in resource-limited settings where cost-effective quality models allow improvement without excessive financial burden. Robust systems encompass standard operating procedures, equipment calibration, internal and external quality control, staff competency reviews, documentation, audits, corrective actions, and risk management. The laboratory workforce – often underappreciated despite their roles in training, testing, validation, and communication – remains central to quality. Skilled, motivated staff are indispensable even when modern equipment exists.

AI offers transformative opportunities for image analysis, predictive analytics, automation, and decision support but faces barriers including limited data availability, weak digital infrastructure, ethical concerns, privacy issues, and algorithmic bias, particularly in LMICs. Successful AI implementation requires investment in data systems, governance, regulation, and technical capacity, with AI complementing rather than replacing human expertise.

Policy implications are clear: Governments must treat diagnostic systems as essential health infrastructure, integrate laboratory networks across care levels, and fund quality management as core operational needs. Investment should balance high-tech innovation with foundational system strengthening, prioritizing specimen transport, staffing, maintenance, and quality control in LMICs. Future directions include digitalization, network integration, quality-driven innovation, and research on laboratory impact metrics, cost-effectiveness, and real-world AI implementation, with greater LMIC representation.

Laboratories bridge biological evidence and clinical action, directly affecting individual outcomes and population health. Their future depends on balancing technology, quality, workforce, and systemic integration, making them increasingly vital in data-driven medicine.

REFERENCES

1. Ahmadi A. Digital health transformation: Leveraging AI for monitoring and disease management. Int J Bio Life Sci (IJBLS) 2024;3:10-24.
2. Babyar J. Laboratory science and a glimpse into the future. Int J Healthc Manag 2020;13:456-63.
3. Binnicker MJ. Emergence of a novel coronavirus disease (COVID-19) and the importance of diagnostic testing: Why partnership between clinical laboratories, public health agencies, and industry is essential to control the outbreak. Clin Chem 2020;66:664-6.
4. Charlton CL, Hull N, Sloma CR, Bonifas M, Johnson M, Strain AK, *et al*. How to prepare for the unexpected: A public health laboratory response. Clin Microbiol Rev 2021;34:e00183-20.
5. Chintala SK. AI in public health: Modelling disease spread and management strategies. NeuroQuantology 2022;20:10830.
6. Chowdhury AT, Newaz M, Saha P, Majid ME, Mushtak A, Kabir MA. Application of big data in infectious disease surveillance: Contemporary challenges and solutions. In: Surveillance, Prevention, and Control of Infectious Diseases: An AI Perspective. Berlin/Heidelberg, Germany: Springer; 2024. p. 51-71.
7. Da Silva SJ, Silva CT, Guarines KM, Mendes RP, Pardee K, Kohl A, *et al*. Clinical and laboratory diagnosis of SARS-CoV-2, the virus causing COVID-19. ACS Infect Dis 2020;6:2319-36.
8. Ferraro S, Braga F, Panteghini M. Laboratory medicine in the new healthcare environment. Clin Chem Lab Med 2016;54:523-33.
9. Funnye-Doby C. Awareness of Clinical Laboratory Sciences and Shortage of Clinical Laboratory Scientists in the 21st Century. Washington, MN, USA, Walden University, [Ph.D. Thesis]; 2016.
10. Greaves RF, Bernardini S, Ferrari M, Fortina P, Gouget B, Gruson D, *et al*. Key questions about the future of laboratory medicine in the next decade of the 21st century: A report from the IFCC-emerging technologies division. Clin Chim Acta 2019;495:570-89.
11. Hanson KE, Altayar O, Caliendo AM, Arias CA, Englund JA, Hayden MK, *et al*. The infectious diseases society of America guidelines on the diagnosis of COVID-19: Antigen testing (June 2021). Clin Infect Dis 2024;78:e208-29.
12. Kumar Y, Koul A, Singla R, Ijaz MF. Retracted article: Artificial intelligence in disease diagnosis: A systematic literature review, synthesizing framework and future research agenda. J Ambient Intell Humaniz Comput 2023;14:8459-86.
13. Lippi G, Plebani M. The critical role of laboratory medicine during coronavirus disease 2019 (COVID-19) and other viral outbreaks. Clin Chem Lab Med 2020;58:1063-9.
14. McClure K. Student perceptions of the clinical laboratory science profession. Clin Lab Sci 2009;22:16-21.
15. Moher D, Schulz KF, Simera I, Altman DG. Guidance for developers of health research reporting guidelines. PLoS Med 2010;7:e1000217.
16. Munagandla VB, Dandyala SS, Vadde BC. AI-powered cloud-based epidemic surveillance system: A framework for early detection. Rev Intel Artif Med 2024;15:673-90.
17. Nega D, Abebe A, Abera A, Gidey B, G/Tsadik A, Tasew G. Comprehensive competency assessment of malaria microscopists and laboratory diagnostic service capacity in districts stratified for malaria elimination in Ethiopia. PLoS One 2020;15:e0235151.
18. Obeagu EI, Obeagu GU. Strengthening laboratory systems for ensuring accurate diagnoses in mother-to-child transmission (MTCT) prevention programs in Uganda: A narrative review. Ann Med Surg (Lond) 2024;86:5256-65.
19. Oduoye MO, Fatima E, Muzammil MA, Dave T, Irfan H, Fariha FN, *et al*. Impacts of the advancement in artificial intelligence on laboratory medicine in low- and middle-income countries: Challenges and recommendations-a literature review. Health Sci Rep 2024;7:e1794.
20. Olatunji AO, Olaboye JA, Maha CC, Kolawole TO, Abdul S. Revolutionizing infectious disease management in low-resource settings: The impact of rapid diagnostic technologies and portable devices. Int J Appl Res Soc Sci 2024;6:1417-32.
21. Ondoa P, Ndlovu N, Keita MS, Massinga-Loembe M, Kebede Y, Odhiambo C, *et al*. Preparing national tiered laboratory systems and networks to advance diagnostics in Africa and meet the continent's health agenda: Insights into priority areas for improvement. Afr J Lab Med 2020;9:1103.
22. Opeyemi AA, Obeagu EI, Hassan AO. Enhancing quality healthcare in Nigeria through medical laboratory services: A review. Medicine (Baltimore) 2024;103:e36869.
23. Pambuccian SE. The COVID-19 pandemic: Implications for the cytology laboratory. J Am Soc Cytopathol 2020;9:202-11.
24. Parsons LM, Somoskovi A, Lee E, Paramasivan CN, Schneidman M, Birx D, *et al*. Global health: Integrating national laboratory health systems and services in resource-limited settings. Afr J Lab Med 2012;1:11.
25. Pradhan S, Gautam K, Pant V. ISO 15189:2022; What's new in new? J Pathol Nepal 2023;13:2027-28.
26. Reller LB, Weinstein MP, Peterson LR, Hamilton JD, Baron EJ, Tompkins LS, *et al*. Role of clinical microbiology laboratories in the management and control of infectious diseases and the delivery of health care. Clin Infect Dis 2001;32:605-11.

27. Santarsiero F, Schiuma G, Carlucci D, Helander N. Digital transformation in healthcare organisations: The role of innovation labs. Technovation 2023;122:102640.
28. Sautter R, Halstead D. The importance of medical laboratory scientists and the number of doctoral scientists that began their career by working on the front lines of laboratory medicine. Lab Med 2023;54:e121-3.
29. Sayed S, Cherniak W, Lawler M, Tan SY, El Sadr W, Wolf N, *et al*. Improving pathology and laboratory medicine in low-income and middle-income countries: Roadmap to solutions. Lancet 2018;391:1939-52.
30. Schwalbe N, Wahl B. Artificial intelligence and the future of global health. Lancet 2020;395:1579-86.
31. Shiwlani A, Khan M, Sherani AM, Qayyum MU, Hussain HK. Revolutionizing healthcare: The impact of artificial intelligence on patient care, diagnosis, and treatment. Jurihum J Inova Dan Hum 2024;1:779-90.
32. Swanson K, Dodd MR, VanNess R, Crossey M. Improving the delivery of healthcare through clinical diagnostic insights: A valuation of laboratory medicine through "clinical lab 2.0". J Appl Lab Med 2018;3:487-97.
33. Thanneru S, Sikka K, Bhalla AS, Tripathi M, Thakar A, Singh A, *et al*. Deciding treatment end point in necrotizing otitis externa: Validation of a standardized clinical response assessment strategy with positron emission tomography findings. Eur Arch Otorhinolaryngol 2025;282:1171-7.
34. Turgeon ML. Clinical Laboratory Science-E-Book: Clinical Laboratory Science-E-Book. Philadelphia, PA, USA: Elsevier Health Sciences; 2022.
35. Verma A, Gupta R. Role of medical laboratory technology in health care. In: Clinical Laboratory Management. Berlin/Heidelberg, Germany: Springer; 2024. p. 3-6.
36. Vian T. Review of corruption in the health sector: Theory, methods and interventions. Health Policy Plan 2008;23:83-94.
37. Watson ID, Wilkie P, Hannan A, Beastall GH. Role of laboratory medicine in collaborative healthcare. Clin Chem Lab Med 2019;57:134-42.
38. Westgard JO. Managing quality vs. Measuring uncertainty in the medical laboratory. Clin Chem Lab Med 2010;48:31-40.

Source of Support: Nil. **Conflicts of Interest:** None declared.