ORIGINAL RESEARCH PAPER
Volume - 15 | Issue - 05 | May - 2026 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

JOB EVOLUTION IN THE AI ERA: OPPORTUNITIES & CHALLENGES IN MEDICAL LABORATORY TECHNOLOGY (MLT)

Laboratory Medicine

Siddharth G. Maske
Department of Medical Laboratory Technology (MLT), Independent Researcher, Maharashtra, India

ABSTRACT

Artificial Intelligence (AI) is transforming Medical Laboratory Technology (MLT) by enhancing diagnostic accuracy, automating routine tasks, and redefining professional roles. This study examines the impact of AI on job responsibilities, opportunities, challenges, and skill requirements among MLT professionals. A cross-sectional survey of 100 participants, including students, technicians, technologists, microbiologists, and educators, was conducted using a structured questionnaire. Findings indicate that AI is already influencing laboratory roles by reducing manual workload and improving efficiency. Key challenges identified include lack of AI training, digital skill gaps, data security concerns, and fear of job displacement. Commonly automated areas include sample processing, digital pathology, and microscopy. Despite concerns, most participants support integrating AI into MLT education. The study concludes that AI will not replace MLT professionals but will shift their roles toward analytical and technology-oriented functions. Strengthening digital skills and incorporating AI training into curricula is essential for future workforce readiness.

KEYWORDS

Artificial Intelligence, Medical Laboratory Technology, Laboratory Automation, Workforce Transformation, Digital Pathology

INTRODUCTION

Background: AI is rapidly transforming laboratory medicine through automation, machine learning, and digital systems, improving accuracy and efficiency. MLT roles are shifting from manual tasks to analytical and supervisory functions.

Research Gap: There is limited field-based research, particularly in India, on how AI affects MLT professionals' roles, skills, and perceptions.

Objective: To analyze the impact of AI on job roles, opportunities, challenges, and training needs in MLT.

Key Focus Areas:
- Tasks affected by AI automation
- Emerging opportunities
- Challenges and concerns
- Skill and training gaps

Research Questions
- How is AI changing MLT job roles?
- Which tasks are most likely to be automated?
- What new opportunities are emerging?
- What challenges do professionals face?
- Are current training programs sufficient?

Hypotheses
- AI is significantly changing MLT roles.
- AI reduces manual workload while creating new roles.
- MLT professionals lack sufficient AI training.
- AI improves accuracy and efficiency.
- Training and curriculum updates will improve AI adoption.

Literature Review

1. AI in Laboratory Medicine

Artificial intelligence has significantly transformed laboratory medicine by improving diagnostic accuracy, reducing errors, and accelerating workflows. Recent studies (2021–2025) show that AI enhances image analysis, supports clinical decision-making, and strengthens quality control across disciplines such as hematology, biochemistry, microbiology, and digital pathology. It also reduces repetitive manual tasks, enabling faster and more consistent results (Paranjpe et al., 2021; Rakha et al., 2021; Hou, 2024; Chopra, 2025).

2. Impact on Workforce

Evidence suggests that AI is reshaping rather than replacing the laboratory workforce. While automation reduces manual tasks, it increases demand for digital skills such as AI validation, data interpretation, and system management. Emerging roles include automation specialists and AI-assisted diagnosticians. However, concerns about skill gaps and unequal adoption highlight the need for structured training and curriculum updates (Al Naam et al., 2022; OECD, 2024; Shen et al., 2025).

3. Automation Trends

There is rapid adoption of Total Laboratory Automation (TLA), robotics, and AI-driven systems, improving efficiency, turnaround time, and accuracy. Current trends emphasize hybrid laboratories, where automation manages physical processes and AI supports analytical tasks. This model requires a technologically skilled workforce to oversee and optimize advanced systems (Nam, 2021; IJCM&PH, 2023; Zhang et al., 2024; Giesriegl et al., 2025).

MATERIALS AND METHODS

This descriptive, cross-sectional survey study included 100 voluntary participants from the Medical Laboratory Technology (MLT) field, including students (DMLT/BMLT/MMLT), laboratory technicians, medical technologists, microbiologists, educators, and laboratory managers from both government and private laboratories in India and abroad.

Data were collected using a structured 10-question questionnaire distributed via Google Forms and automatically compiled in Google Sheets. The questionnaire assessed perceptions of AI's impact on job roles, task automation, training adequacy, diagnostic accuracy, skill requirements, and overall opportunities versus challenges.

Data analysis was performed using Google Sheets, applying descriptive statistics such as percentages and frequency distribution. Charts and tables were generated for visualization. Additionally, national and international discussions via Zoom were conducted to support and validate findings through thematic analysis.

The study followed ethical standards with voluntary participation, anonymity, and informed consent implied through form submission. As no personal or sensitive data were collected, formal ethical approval was not required.

RESULTS AND DISCUSSION

The study analyzed responses across five key areas: awareness and perception of AI, tasks likely to be automated, challenges and concerns, training gaps, and overall impact.

Most participants acknowledged that AI is transforming MLT roles, particularly in routine and repetitive laboratory tasks, and believed it could improve diagnostic accuracy and efficiency. However, concerns were raised regarding job displacement, lack of training, and adaptation challenges.

A significant proportion reported inadequate training in AI technologies, highlighting the need for curriculum updates and skill enhancement. Participants emphasized the importance of developing digital, analytical, and AI-related competencies.

Overall, the findings suggest that while AI presents certain challenges, it is widely perceived as creating more opportunities than threats,

particularly through workload reduction, improved diagnostics, and the emergence of new specialized roles in laboratory science.

1. AI Awareness and Perception in MLT

Most participants acknowledged that AI is transforming MLT roles, though awareness levels vary. Private laboratories show higher adoption, while government settings remain in early stages. Senior professionals have limited technical familiarity, whereas students demonstrate strong interest. Overall, awareness is increasing, but practical exposure remains limited.

2. MLT Tasks Likely to Be Automated

AI is expected to primarily handle routine tasks such as sample processing, digital pathology, report generation, and microscopy. Human professionals are likely to retain responsibility for validation and final decision-making. This indicates a shift toward automation of repetitive processes while preserving human oversight.

3. Challenges and Concerns

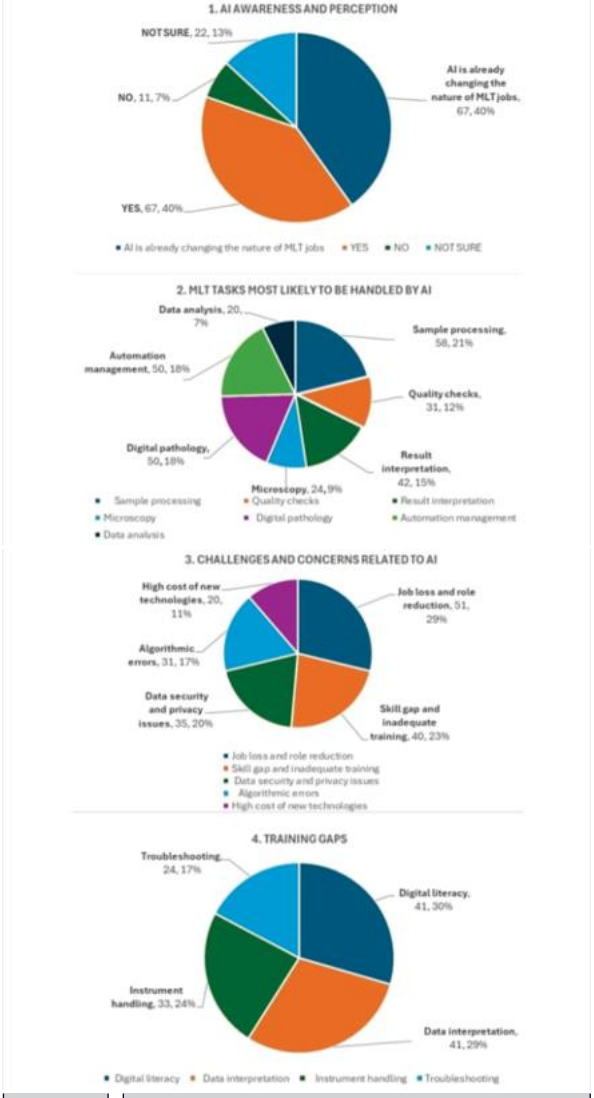
Key concerns include skill gaps, insufficient training, job insecurity, data privacy risks, high implementation costs, and potential algorithmic errors. Among these, lack of training and data security emerge as the most critical barriers to AI adoption.

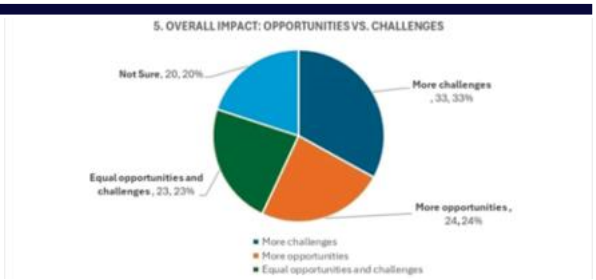
4. Training Gaps in AI Adoption

Participants identified deficiencies in digital literacy and data interpretation as major gaps, followed by limited skills in instrument handling and troubleshooting. Current MLT education lacks AI integration, highlighting the need for updated curricula and continuous professional training.

5. Overall Impact: Opportunities vs. Challenges

While AI offers opportunities in automation and digital diagnostics, most participants perceive greater challenges, particularly due to inadequate training and job-related concerns. Successful integration of AI in MLT will depend largely on skill development and workforce adaptation.





Interpretation

1. AI Usage: Most participants have not used AI in laboratory work, showing limited exposure to AI in MLT.
2. Workload Reduction: Many believe AI can reduce manual workload and improve lab efficiency.
3. Training Adequacy: Participants were unsure about receiving enough training for AI, indicating the need for better learning programs.
4. Diagnostic Accuracy: Most agreed that AI can improve the speed and accuracy of diagnostic testing.
5. AI in the Curriculum: There was strong support for including AI in the MLT curriculum, showing readiness for modernized education.
6. Changing Job Roles: Participants felt that AI is already changing MLT job roles and laboratory practices.
7. Tasks Likely to Be Automated: Sample processing was seen as the most likely task to be automated. Automation management and digital pathology were also commonly selected. Result interpretation, quality control, and microscopy received moderate support.Data analysis was selected by fewer participants.
8. Challenges and Concerns: Major concerns: skill gaps, lack of training, and data privacy issues.Less concern: job loss, role reduction, and algorithm errors.High cost was not a major concern.
9. Training Gaps: The biggest gap was digital literacy.Followed by data interpretation and instrument handling.Troubleshooting was not seen as a major problem.
10. Opportunities vs. Challenges: Most felt there are more challenges than opportunities with AI right now.Some believed both are balanced. A few were unsure about the overall impact.

CONCLUSION

Most participants have not yet used AI in laboratory practice but show a positive attitude toward its potential. They believe AI can reduce workload and improve diagnostic speed and accuracy. However, uncertainty about training highlights the need for better educational support. Strong support for including AI in the MLT curriculum reflects its growing influence on laboratory roles, especially in automation and digital pathology. While skill gaps and data privacy remain concerns, overall perceptions suggest that with proper training, AI can significantly enhance laboratory efficiency and quality.

Implications

The findings indicate limited preparedness for AI integration despite positive perceptions. There is a clear need to strengthen digital literacy, improve training, and update the MLT curriculum to ensure safe and effective AI use in laboratories.

Recommendations

- Develop structured AI training programs to improve digital literacy and data interpretation.
- Integrate AI concepts, applications, and ethics into the MLT curriculum.
- Identify and address barriers to AI adoption in laboratories.
- Conduct studies on AI effectiveness in key lab tasks such as sample processing and digital pathology.
- Evaluate training programs to improve confidence in AI use.
- Strengthen data privacy and security measures.
- Carry out follow-up studies to assess changing perceptions of AI in MLT.

REFERENCES

1. Paranjpe, K., et al. (2021). Value of artificial intelligence in laboratory medicine. American Journal of Clinical Pathology, 155(6), 823–830.
2. Rakha, E. A., et al. (2021). Current and future applications of artificial intelligence in pathology. Journal of Clinical Pathology, 74(7), 409–415.
3. Nam, Y. A. (2021). Pioneering trends in total laboratory automation. Korean Journal of Laboratory Medicine.
4. Al Naam, Y. A., et al. (2022). The impact of total automation on the clinical laboratory workforce: A case study. Clinical Laboratory Workforce Studies.

5. Rabbani, N., et al. (2022). Applications of machine learning in routine laboratory medicine: A review. Frontiers in Medicine.
6. International Journal of Community Medicine and Public Health. (2023). The impact of laboratory automation on efficiency and workforce. IJCM&PH.
7. Oduoye, M. O., et al. (2024). Impacts of advancing artificial intelligence on laboratory medicine. Laboratory Medicine Context.
8. Xie, H., et al. (2024). Integration of AI in clinical laboratory medicine. International Journal of Medical Diagnostics.
9. Khwaji, A. H., et al. (2024). Impact of laboratory automation and AI on healthcare delivery. Journal of Health Sciences and Nursing, 10(2).
10. McGenity, C., et al. (2024). AI in digital pathology: A systematic review. NPJ Digital Medicine, 7.
11. Hou, H. (2024). Artificial intelligence in the clinical laboratory. Clinical Chemistry.
12. Zhang, D. Y., et al. (2024). Digital pathology and AI: Recent advances. Journal of Pathology & Histopathology Reviews.
13. OECD. (2024). Artificial intelligence and the health workforce. OECD Publishing.
14. Chopra, S. (2025). AI in clinical laboratory settings. Journal of Laboratory Physicians, 17(2).
15. Giesriegl, F., et al. (2025). Integrating AI and automation in laboratory medicine. Journal of Laboratory and Precision Medicine.
16. Ashraf, A. A., et al. (2025). AI in diagnostics and patient care. Diagnostic Microbiology & Infectious Disease.
17. Habibur, M. H., et al. (2025). Future of AI in laboratory medicine. PrimeAsia Journal, 6(1), 1–6.
18. Pillay, T. S., et al. (2025). AI for evidence-based laboratory medicine. Evidence-Based Laboratory Medicine Review.
19. Cocuz, I. G. (2025). Trends in digital pathology and AI. Digital Pathology Review.
20. Shen, I. Z., et al. (2025). AI-based pathology: Benefits and challenges. Journal of Computational and Translational Pathology.