fortune Journals

Research Article

ARCHIVES OF
CLINICAL AND
BIOMEDICAL RESEARCH

ISSN: 2572-5017

Artificial Intelligence in Diagnostic Laboratories: Knowledge, Attitude and Practice among Laboratory Professionals in Bangladesh

Anuradha Paul Tithi[1], Md. Akram Hossen[2], Md Borhan Uddin Sohan[3], Kamrul Hasan[4], Nourin Jahan Misho[5], Md. Sharfuddin[6], Mst. Momana Akter Mim[7], Rifatul Jannat Rifat[8*]

Abstract

Background: Artificial Intelligence (AI) is increasingly transforming diagnostic laboratory services by improving diagnostic accuracy, workflow efficiency, automation, and quality assurance. Despite the growing global integration of AI into laboratory medicine, its adoption in Bangladesh remains limited because of inadequate infrastructure, insufficient training opportunities, and limited awareness among laboratory professionals.

Objective: To assess the knowledge, attitude, and practice (KAP) regarding Artificial Intelligence among laboratory professionals working in diagnostic laboratories in Bangladesh.

Methods: A multicenter cross-sectional study was conducted among laboratory professionals employed in private diagnostic centers and hospital-based diagnostic laboratories in Dhaka and selected divisional cities of Bangladesh between July and December 2025. A total of 300 participants were recruited using convenience sampling. Data were collected using a structured, pretested, self-administered questionnaire distributed through Google Forms. The questionnaire assessed socio-demographic characteristics, professional background, AI-related knowledge, attitudes, and practice. Statistical analyses were performed using SPSS version 26. Chi-square tests, Pearson's correlation analysis, and multivariable logistic regression were applied to identify factors associated with AI knowledge. A p-value <0.05 was considered statistically significant.

Results: Among the 300 participants, 184 (61.3%) were male and 116 (38.7%) were female, with a mean age of 33.9 ± 8.4 years. Medical technologists constituted the majority of respondents (68.0%), followed by laboratory scientists (15.0%), laboratory managers/supervisors (10.0%), and pathologists (7.0%). Only 22.3% of participants reported being familiar with AI applications in laboratory medicine. Overall, 15.0% demonstrated good knowledge, 25.5% had moderate knowledge, and 59.5% had poor knowledge regarding AI technologies. Participants generally demonstrated a cautious perception toward AI adoption. Only 42.7% expressed a positive attitude toward future AI implementation in diagnostic laboratories, whereas 57.3% showed a negative or uncertain attitude. Approximately 55.0% believed that AI could improve diagnostic accuracy, reduce human errors, and enhance laboratory efficiency. However, substantial concerns were identified: 76.0% reported inadequate AI knowledge and lack of training opportunities, 68.7% believed that Bangladesh lacks adequate infrastructure and institutional preparedness for AI implementation, 65.3% expressed concerns regarding the high cost of AI technologies, 64.3% feared that AI-driven automation could reduce employment opportunities for laboratory professionals, particularly medical technologists, 61.7% were concerned about data privacy and cybersecurity, and 58.0% believed excessive dependence on AI might

Affiliation:

[1]Department of Quality Control, Drug International Limited, Dhaka, Bangladesh

[2]Department of Biochemistry & Molecular Biology, University of Rajshahi, Rajshahi, Bangladesh

[3]Department of Occupational Therapy, Centre for the Rehabilitation of the Paralysed, Dhaka, Bangladesh

[4]Department of Oncology, Labaid Cancer Hospital, Dhaka, Bangladesh

[5]Department of CSE, University of Information Technology & Sciences, Dhaka, Bangladesh

[6]Department of Computer Science and Engineering, Southeast University, Dhaka, Bangladesh

[7]Department of Nursing Science and Midwifery, East West Nursing College and Institute, Dhaka, Bangladesh

[8]Faculty of Preventive and Social Medicine, Sir Salimullah Medical College, Dhaka, Bangladesh

***Corresponding author:**
Rifatul Jannat Rifat, Faculty of Preventive and Social Medicine, Sir Salimullah Medical College, Dhaka, Bangladesh

Citation: Anuradha Paul Tithi, Md. Akram Hossen, Md Borhan Uddin Sohan, Kamrul Hasan,Nourin Jahan Misho,Md. Sharfuddin, Mst. Momana Akter Mim, Rifatul Jannat Rifat. Artificial Intelligence in Diagnostic Laboratories: Knowledge, Attitude and Practice among Laboratory Professionals in Bangladesh. Archives of Clinical and Biomedical Research. 10 (2026): 218-223.

Received: July 14, 2026
Accepted: July 17, 2026
Published: July 27, 2026

Tithi AP, et al., Arch Clin Biomed Res 2026
0DOI:10.26502/acbr.50170528

reduce professional judgment and practical laboratory skills. Practical exposure to AI was very limited, with only 8.7% reporting direct experience using AI-assisted laboratory systems and 7.3% having received formal AI-related training. Participants who had received AI training demonstrated significantly higher knowledge scores than untrained participants (48.2% vs. 11.4%, $p < 0.001$). Knowledge scores showed a moderate positive correlation with attitude scores ($r = 0.34$, $p < 0.001$) and practice scores ($r = 0.28$, $p < 0.001$). Attitude scores were also positively correlated with practice scores ($r = 0.23$, $p = 0.004$). Multivariable logistic regression identified postgraduate education (AOR = 2.08; 95% CI: 1.12–3.84; $p = 0.019$), previous AI-related training (AOR = 3.56; 95% CI: 1.82–6.96; $p < 0.001$), and employment in large urban diagnostic centers (AOR = 1.81; 95% CI: 1.01–3.24; $p = 0.046$) as independent predictors of good AI knowledge.

Conclusion: Laboratory professionals in Bangladesh demonstrated limited knowledge and very low practical exposure to Artificial Intelligence despite its growing importance in laboratory medicine. Negative perceptions were common, primarily driven by inadequate training, weak institutional preparedness, concerns about job displacement, high implementation costs, and data security issues.

Keywords: Artificial Intelligence; Diagnostic Laboratories; Laboratory Professionals; Knowledge, Attitude and Practice; Laboratory Medicine; Bangladesh.

Introduction

Artificial Intelligence (AI) has emerged as one of the most transformative technologies in healthcare, revolutionizing disease diagnosis, clinical decision-making, laboratory automation, and healthcare management. By integrating advanced computational techniques, including machine learning, deep learning, natural language processing, and computer vision, AI enables the analysis of complex medical data with remarkable speed and accuracy [1]. In diagnostic laboratories, AI has the potential to enhance analytical precision, reduce human error, optimize workflow efficiency, improve quality assurance, and support evidence-based clinical decision-making. As laboratory medicine increasingly embraces digital transformation, AI is expected to play a pivotal role in improving diagnostic services and patient outcomes [2]. Globally, AI has been incorporated into various aspects of laboratory medicine, including automated microscopy, digital pathology, hematology image interpretation, clinical chemistry result validation, molecular diagnostics, microbiology, laboratory information systems, and predictive analytics. AI-assisted technologies have demonstrated promising performance in detecting abnormal laboratory findings, identifying disease patterns, improving turnaround time, and reducing repetitive manual tasks. Consequently, many developed countries have begun integrating AI-based solutions into routine laboratory practice to improve operational efficiency while maintaining high standards of diagnostic quality and patient safety [3]. Despite these advancements, the implementation of AI in low- and middle-income countries remains limited. Bangladesh is currently undergoing rapid digitalization within its healthcare sector; however, the adoption of AI in diagnostic laboratories is still at an early stage [4]. Major barriers include limited technical infrastructure, inadequate financial investment, lack of institutional preparedness, insufficient AI-focused education and professional training, concerns regarding data privacy and cybersecurity, and uncertainty surrounding regulatory and ethical frameworks. Furthermore, many laboratory professionals remain apprehensive about AI due to fears of job displacement, reduced professional autonomy, and the absence of clear national policies governing AI implementation in healthcare [5]. The successful integration of AI into laboratory medicine depends not only on technological advancement but also on the knowledge, perceptions, acceptance, and readiness of laboratory professionals. Adequate knowledge facilitates appropriate utilization of AI tools, positive attitudes encourage adoption of innovative technologies, and practical experience enhances confidence in implementing AI-assisted laboratory systems. Conversely, inadequate knowledge and negative perceptions may delay the successful integration of AI into routine diagnostic practice, even when technological resources become available [6]. Knowledge, Attitude, and Practice (KAP) studies provide valuable insight into healthcare professionals' awareness, perceptions, and real-world utilization of emerging technologies. Although several studies from high-income countries have evaluated healthcare professionals' perceptions of AI, evidence focusing specifically on laboratory professionals remains limited, particularly in South Asia. Therefore, the present study aimed to assess the knowledge, attitude, and practice regarding Artificial Intelligence among laboratory professionals working in diagnostic laboratories in Bangladesh.

Methodology

A multicenter cross-sectional study was conducted among laboratory professionals employed in private diagnostic laboratories, hospital-based diagnostic laboratories, and private hospital laboratories across Dhaka, Sylhet, Chattogram, and Rajshahi, Bangladesh, between July and December 2025. Registered laboratory professionals, including medical technologists, laboratory scientists, laboratory managers or supervisors, and pathologists who were actively involved in diagnostic laboratory services and provided informed consent were eligible for participation.

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Individuals not directly engaged in laboratory practice, incomplete responses, and duplicate submissions were excluded from the analysis. A total of 300 participants were recruited using a convenience sampling technique. Data were collected through a structured, pretested, self-administered questionnaire developed following a comprehensive review of the literature on Artificial Intelligence in healthcare and laboratory medicine. The questionnaire was prepared in English and administered electronically using Google Forms through professional laboratory networks, institutional communication channels, and social media platforms. Prior to the main survey, the questionnaire was pilot-tested among a small group of laboratory professionals to evaluate its clarity, relevance, and content validity, and minor revisions were made accordingly. The questionnaire comprised four domains: socio-demographic and professional characteristics, knowledge, attitude, and practice regarding Artificial Intelligence in diagnostic laboratory services. Socio-demographic variables included age, sex, educational qualification, professional designation, years of experience, type of workplace, and geographical location. The knowledge domain assessed participants' understanding of AI concepts, laboratory applications, and awareness of AI-assisted technologies. The attitude domain evaluated perceptions regarding the usefulness, acceptance, trust, ethical concerns, employment-related issues, data security, and future adoption of AI. The practice domain assessed previous AI-related training, practical experience with AI-assisted laboratory systems, participation in AI-focused educational activities, and willingness to incorporate AI into routine laboratory practice. Responses were collected using multiple-choice questions and five-point Likert scale items where appropriate. Following data collection, responses were reviewed for completeness and consistency before being exported from Google Forms to Microsoft Excel for cleaning and coding. Statistical analyses were performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Associations between categorical variables were examined using the Chi-square test. Pearson's correlation coefficient was used to evaluate relationships among knowledge, attitude, and practice scores. Multivariable logistic regression analysis was performed to identify factors independently associated with good knowledge of Artificial Intelligence. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were reported, and a two-tailed p-value of <0.05 was considered statistically significant.

Participation was voluntary, and electronic informed consent was obtained from all participants before questionnaire completion. Participant anonymity and data confidentiality were strictly maintained throughout the study by ensuring that no personally identifiable information was collected. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and received approval from the appropriate Institutional Review Board prior to data collection.

Results

A total of 300 laboratory professionals participated in this multicenter cross-sectional study. The socio-demographic and professional characteristics of the participants are presented in Table 1. Among the respondents, 184 (61.3%) were male and 116 (38.7%) were female, with a mean age of 33.9 ± 8.4 years. Medical technologists constituted the largest professional group (68.0%), followed by laboratory scientists (15.0%), laboratory managers/supervisors (10.0%), and pathologists (7.0%).

Table 1: Socio-demographic and Professional Characteristics of Participants (n = 300).

Variables	Number (n)	Percentage (%)
Gender		
Male	184	61.3
Female	116	38.7
Mean age (years)	33.9 ± 8.4	
Profession		
Medical Technologist	204	68
Laboratory Scientist	45	15
Laboratory Manager/Supervisor	30	10
Pathologist	21	7

The overall knowledge, attitude, and practice regarding Artificial Intelligence (AI) among the participants are summarized in Table 2. Only 22.3% of the respondents reported being familiar with AI applications in diagnostic laboratory practice, whereas 77.7% had little or no familiarity with AI technologies. Assessment of knowledge demonstrated that only 15.0% of participants had good knowledge, while 25.5% had moderate knowledge and 59.5% had poor knowledge regarding AI applications in laboratory medicine. Regarding attitudes toward AI implementation, 42.7% of participants expressed a positive attitude, whereas 57.3% demonstrated a negative or uncertain attitude. Although more than half of the respondents (55.0%) believed that AI could improve diagnostic accuracy, reduce human error, and enhance laboratory efficiency, several important concerns were identified. The majority reported inadequate AI-related knowledge and lack of training opportunities (76.0%), followed by inadequate infrastructure and institutional preparedness in Bangladesh (68.7%), high implementation costs (65.3%), fear of job displacement due to automation (64.3%), concerns regarding data privacy and cybersecurity (61.7%), and apprehension that excessive reliance on AI

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could reduce professional judgment and practical laboratory skills (58.0%). Practical exposure to AI was very limited, with only 8.7% reporting previous experience with AI-assisted laboratory systems and only 7.3% having received formal AI-related training.

Table 2: Knowledge, Attitude and Practice Regarding Artificial Intelligence (n = 300).

Variables	n	%
Familiar with AI applications	67	22.3
Not familiar with AI	233	77.7
Knowledge level		
Good	45	15
Moderate	77	25.5
Poor	178	59.5
Attitude		
Positive attitude	128	42.7
Negative/Uncertain attitude	172	57.3
Believe AI improves diagnostic accuracy	165	55
Concern about inadequate AI training	228	76
Concern about poor AI infrastructure	206	68.7
Concern about implementation cost	196	65.3
Fear of job displacement	193	64.3
Concern about data privacy/cybersecurity	185	61.7
Concern about loss of professional skills	174	58
Direct AI experience	26	8.7
Formal AI training	22	7.3

The associations between participants' characteristics and good knowledge of Artificial Intelligence are presented in Table 3. AI-related training showed the strongest association with good knowledge ($p < 0.001$). Participants with postgraduate education were significantly more likely to demonstrate good knowledge than those with lower educational qualifications ($p = 0.019$). Similarly, professionals employed in large urban diagnostic laboratories had significantly higher knowledge levels than those working in other laboratory settings ($p = 0.045$). No statistically significant associations were observed between knowledge level and gender or professional designation ($p > 0.05$).

Independent predictors of good knowledge regarding Artificial Intelligence are presented in Table 4. After adjustment for potential confounding variables, postgraduate education remained significantly associated with good AI knowledge (AOR = 2.08; 95% CI: 1.12–3.84; $p = 0.019$). Participants who had received AI-related training were more than three times as likely to possess good knowledge compared with those without training (AOR = 3.56; 95% CI: 1.82–6.96; $p < 0.001$). In addition, employment in a large urban diagnostic center was identified as an independent predictor of good AI knowledge (AOR = 1.81; 95% CI: 1.01–3.24; $p = 0.046$).

Pearson's correlation analysis demonstrated significant positive relationships among knowledge, attitude, and practice scores (Table 5). Knowledge scores were moderately correlated with attitude scores ($r = 0.34$, $p < 0.001$) and practice scores ($r = 0.28$, $p < 0.001$), indicating that participants with better knowledge tended to have more

Table 3: Association Between Participants' Characteristics and Good Knowledge of Artificial Intelligence.

Variables	Good Knowledge n (%)	Poor/Moderate Knowledge n (%)	χ^2	p-value
Gender				
Male (n=184)	33 (17.9)	151 (82.1)	1.72	0.19
Female (n=116)	12 (10.3)	104 (89.7)		
Education				
Bachelor's or below (n=188)	18 (9.6)	170 (90.4)	5.48	**0.019**
Postgraduate (n=112)	27 (24.1)	85 (75.9)		
AI-related training				
Yes (n=22)	11 (50.0)	11 (50.0)	22.84	**<0.001**
No (n=278)	34 (12.2)	244 (87.8)		
Workplace				
Large urban diagnostic center (n=176)	34 (19.3)	142 (80.7)	4.02	**0.045**
Other laboratories (n=124)	11 (8.9)	113 (91.1)		
Professional designation				
Medical technologist (n=204)	28 (13.7)	176 (86.3)	2.31	0.128
Other laboratory professionals (n=96)	17 (17.7)	79 (82.3)		

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Table 4: Multivariable Logistic Regression Analysis for Predictors of Good AI Knowledge.

Variables	AOR	95% CI	p-value
Postgraduate education	2.08	1.12–3.84	0.019
Previous AI training	3.56	1.82–6.96	<0.001
Employment in urban diagnostic center	1.81	1.01–3.24	0.046

Table 5: Pearson Correlation Between Knowledge, Attitude and Practice Scores.

Variables	Knowledge	Attitude	Practice
Knowledge	1	0.34**	0.28**
Attitude	0.34**	1	0.23*
Practice	0.28**	0.23*	1

** $p < 0.001$; * $p = 0.004$

favorable attitudes and greater practical engagement with AI. A weaker but statistically significant positive correlation was also observed between attitude and practice scores ($r = 0.23$, $p = 0.004$), suggesting that a more positive perception of AI was associated with greater willingness to adopt and utilize AI technologies in diagnostic laboratory practice.

Discussion

The findings indicate that AI awareness and practical exposure remain limited despite increasing global adoption of AI in laboratory medicine. The study also identified several barriers, including inadequate training, poor infrastructure, high implementation costs, concerns about data privacy, and fear of job displacement, which may impede AI integration into diagnostic laboratories. A key finding of this study was the limited knowledge of AI among laboratory professionals. Only 22.3% of participants were familiar with AI applications in laboratory medicine, while only 15.0% demonstrated good knowledge and 59.5% had poor knowledge. These findings suggest that AI literacy among laboratory professionals in Bangladesh is still at an early stage. This may be attributed to the limited inclusion of AI-related topics in medical laboratory science curricula, the lack of structured professional training, and minimal exposure to AI-assisted laboratory technologies in routine diagnostic practice [7]. Although AI knowledge was limited, participants showed mixed perceptions regarding its future implementation. While 42.7% expressed a positive attitude, the majority (57.3%) reported negative or uncertain attitudes. Nevertheless, 55.0% believed that AI could improve diagnostic accuracy, reduce human error, and enhance laboratory efficiency. These findings indicate that laboratory professionals recognize the potential benefits of AI but remain cautious about its implementation because of existing technical and organizational challenges [8]. The most frequently reported barrier was the lack of AI-related knowledge and training opportunities (76.0%), followed by inadequate infrastructure and institutional preparedness (68.7%), high implementation costs (65.3%), fear of job displacement (64.3%), concerns regarding data privacy and cybersecurity (61.7%), and apprehension that AI may reduce professional judgment and practical laboratory skills (58.0%). These findings highlight that successful AI implementation requires not only technological advancement but also workforce preparedness, institutional investment, appropriate regulatory frameworks, and continuous professional development programs [9]. Practical utilization of AI was extremely limited. Only 8.7% of participants reported direct experience with AI-assisted laboratory systems, and merely 7.3% had received formal AI-related training. This finding reflects the current status of AI implementation in Bangladesh, where AI technologies are still unavailable in most routine diagnostic laboratories and structured training opportunities remain scarce. The present study also identified several important determinants of AI knowledge. Participants with postgraduate education were more likely to demonstrate good knowledge than those with lower educational qualifications (AOR = 2.08; 95% CI: 1.12–3.84; $p = 0.019$). Previous AI-related training emerged as the strongest independent predictor of good knowledge (AOR = 3.56; 95% CI: 1.82–6.96; $p < 0.001$), while employment in large urban diagnostic laboratories was also significantly associated with higher knowledge (AOR = 1.81; 95% CI: 1.01–3.24; $p = 0.046$). These findings emphasize that education, training, and workplace resources play a critical role in improving AI readiness among laboratory professionals [10]. Furthermore, significant positive correlations were observed among knowledge, attitude, and practice. Knowledge was moderately correlated with attitude ($r = 0.34$, $p < 0.001$) and practice ($r = 0.28$, $p < 0.001$), while attitude was positively associated with practice ($r = 0.23$, $p = 0.004$). These relationships suggest that improving AI knowledge through structured education and professional training may foster more positive attitudes and encourage greater adoption of AI technologies in routine laboratory practice.

Conclusion

Laboratory professionals in Bangladesh demonstrated limited knowledge and very low practical exposure to Artificial Intelligence despite recognizing its potential to improve diagnostic laboratory services. Insufficient training, inadequate infrastructure, high implementation costs, data security concerns, and fear of job displacement were identified as the major barriers to AI adoption. Strengthening AI-focused education, professional training, laboratory infrastructure, and national implementation strategies will be essential to enhance AI readiness and support the safe and effective integration of AI into diagnostic laboratory practice in Bangladesh.

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Limitations of the Study

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional study design limits the ability to establish causal relationships between participants' characteristics and AI-related knowledge, attitudes, and practices. Second, convenience sampling was used, which may introduce selection bias and limit the generalizability of the findings to all laboratory professionals in Bangladesh. Third, the study relied on self-administered questionnaires, making the results susceptible to recall bias, response bias, and social desirability bias. Fourth, most participants were recruited from private diagnostic laboratories and hospital-based laboratories located in major urban cities, which may not adequately represent laboratory professionals working in rural or resource-limited healthcare settings. Finally, the study assessed self-reported knowledge and practice rather than objectively measuring AI competency or actual utilization of AI technologies in routine laboratory practice. Despite these limitations, the study provides valuable baseline evidence regarding the current level of AI awareness, perceptions, and practice among laboratory professionals in Bangladesh and may serve as a foundation for future nationwide studies and policy development.

Conflict of Interest: No

Author Contributions Conceptualization

Anuradha Paul Tithi, Md. Akram Hossen, Md. Sharfuddin

Methodology

Anuradha Paul Tithi, Md. Akram Hossen, Kamrul Hasan, Md. Sharfuddin

Data Collection

Anuradha Paul Tithi, Md Borhan Uddin Sohan, Nourin Jahan Misho, Mst. Momana Akter Mim, Rifatul Jannat Rifat

Data Curation

Md Borhan Uddin Sohan, Kamrul Hasan, Nourin Jahan Misho, Mst. Momana Akter Mim

Formal Analysis

Md. Akram Hossen, Md. Sharfuddin, Kamrul Hasan

Writing – Original Draft

Anuradha Paul Tithi, Md. Akram Hossen, Md. Sharfuddin

Writing – Review & Editing

Md. Akram Hossen, Kamrul Hasan, Md. Sharfuddin, Rifatul Jannat Rifat

Final Approval

Anuradha Paul Tithi, Md. Akram Hossen, Md Borhan Uddin Sohan, Kamrul Hasan, Nourin Jahan Misho, Md. Sharfuddin, Mst. Momana Akter Mim, and Rifatul Jannat Rifat. All authors read and approved the final manuscript.

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