

Original Research Article

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## Applying Artificial Intelligence in Clinical Laboratory: Clinical Laboratory Professionals' Perception

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### ABSTRACT

#### Keywords

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Development of technology in recent years supported the medical fields with Artificial Intelligence (AI) and machine learning (ML) models. These tools help in medical diagnosis, decision making, and design the treatment protocols. The clinical laboratory is the cornerstone of healthcare process; it supports physicians with investigations' result which significantly affect on treatment plan. This study aims to measure the attitude of the clinical laboratory professionals toward AI/ML in medical diagnosis, their knowledge, experiences, concerns, and their compatibility with AI/ML applications in medical diagnosis. In this study conducted a cross-sectional, the only clinical laboratories professionals in Hafr El-Batin, Saudi Arabia were targeted by this questionnaire. The study was conducted in the period from September to October 2023. The questionnaire included self-reported information on AI or ML knowledge, experience, personal thoughts, and level of agreement with different aspects of AI and ML in medical diagnosis. A total of 102 responses were received from 500 distributed surveys (response rate 20%). Out of eligible (96%) out of 102 received responses, 98 were eligible. Regarding previous experiences with AI/ML, 56.7% of the clinical lab professionals have answered (Yes) while 42.3% answered (No). Regarding attitude, the survey showed most respondents 58% suspected that using AI may save time and cost, and 64.1 are worried that AI may replace their jobs in the future. Subgroup analysis showed a significant difference between the participants who used AI and those with no previous experience of using AI and ML. This means that clinical lab professionals that dealt showed positive opinion regarding using AI and ML in clinical labs. There is a limited knowledge about AI technologies and concern about potential consequence of its implementation in the medical field. Further studies are needed to investigate the attitude regarding AI application, better education and regulatory framework are required as well.

## Introduction

Artificial Intelligence (AI) is a field of data science, where computers can learn to analyze big data and human interaction. This technology enables machines to imitate human thinking, predict the results, continue learning, and take decisions based on the generated findings. There is evidence supporting that these computers have performances similar or superior to humans in a faster and cost-effective manner (Markoff, 2015; Borowiec, 2016). From the early of 2000s, AI and its subclasses, such as machine learning (ML) along with deep learning (DL), have become remarkably prominent in the field of medicine. These technologies serve as instruments for creating diagnostic algorithms, forecasting a patient's likelihood of survival, assisting in medical diagnostic procedures, and recommending appropriate treatment protocols (Dlamini *et al.*, 2020). Implementation of AI and ML into clinical laboratory requires extensive data collection, training, and testing. Nevertheless, employing big data in this context is challenging process (Benke, 2018). Primarily, storage, management, and processing of vast amounts of data is challenging. Moreover, big data includes various types, including structured, unstructured, and semi-structured data which adding complexity to its integration and manipulation. The swift generation of data and processing speed can also strain traditional systems. Deriving meaningful insights and value from big data necessitates advanced analytical tools and efficient processing and analytical techniques. Despite these challenges, numerous researchers and scientists have effectively addressed these issues, leading to the development of several successful AI/ML algorithms currently applied in medical diagnosis (Ahmed *et al.*, 2022).

Currently, AI and ML can be employed extensively in clinical laboratories. Many applications of AI with ML have been implemented in this field such as image analysis, prediction of multiple drug resistant microbes and identify patterns or features that signify specific diseases. This capability is especially valuable for detecting early-stage or

subtle disease signs that might escape visual observation (Prabhakar *et al.*, 2021). Also, there are a considerable amount of data is generated during the healthcare process, including laboratory results and patient records. AI tools can analyze this data, identifying patterns or associations that may elude human analysts (Alagappan *et al.*, 2018). Finally, AI system can utilize this data in decision-making, provide recommendations, and the appropriate course action based on data analysis result (Meyer *et al.*, 2022). In conclusion implementation of AI and ML in clinical laboratory can improve accuracy and efficiency of clinical diagnosis and support healthcare process (Ahmed *et al.*, 2023). This study is aiming to measure the attitude of the clinical laboratory professionals toward AI/ML in medical diagnosis, their knowledge, experiences, concerns, and their compatibility with AI/ML applications in medical diagnosis. Additionally, the study investigates the possibility of predicting whether the participants used or did not use AI/ML earlier based on their answers.

## Materials and Methods

In the present study evaluated the knowledge and opinions of clinical laboratory professionals in Hafr El-Batin about applying AI and ML in the clinical laboratories. For this purpose, in this study used the cross-sectional-based online questionnaire. The questionnaire was created using “google forms” platform and sent to the medical staff through the work email.

## Study participants

The only clinical laboratories professionals in Hafr El-Batin, Saudi Arabia were targeted by this questionnaire. The study was conducted in the period from September to October 2023. The responses were recorded after the participant pressed submit button at the end of the questionnaire. The questionnaire allowed a single response from each participant, and all questionnaire bands were mandatory. Any responses from non-healthcare professionals were excluded.

## Ethics approval

The study was approved by the Health Ethics committee at the general directorate of health affairs in Hafr El-Batin, Saudi Arabia. The study didn't include a sensitive subject with no informational risk or psychological harm. The study was performed according to the principles of the Declaration of Helsinki. Informed consent was added to the survey, by pressing the submit button the participant accepts filling out the survey.

## Survey

The survey was created in light of the study checklist for reporting results of the electronic survey (CHERRIES), and the previous studies conducted to evaluate knowledge of pathologists at Poland and the study conducted by the Royal Free London NHS Foundation Trust (Ahmed *et al.*, 2023; Castagno and Khalifa, 2020; Hawking *et al.*, 2014). The questions were categorized into two parts; the first part included age, gender, medical year of experience, the second part was assessing the knowledge of clinical laboratories professionals on AI, evaluating the attitude and worries about its current and future applications in the medical diagnosis.

## Statistical analysis

SPSS version 25.0 was used to analyze the data. The survey result was analyzed as numbers and percentages. Subgroup analysis was conducted using the *Kruskal-Wallis* test followed by *post-hoc* pairwise Mann-Whitney U tests with Bonferroni correction for multiple tests to examine the source of variance in knowledge and attitudes between different healthcare professions.

## Results and Discussion

### Demographic Data of the Participants

A total of 102 responses were received from 500 distributed surveys (response rate 20%). Out of

eligible (96%) out of 102 received responses, 98 were eligible, and 4 responses were excluded because they were received from non-clinical lab professionals. Cronbach's standardized alpha demonstrated a good reliability  $\alpha = 0.79$  Table 2. Participants' ages ranged from 28 to 48 years Table 1.

### Knowledge regarding AI

Regarding previous experiences with AI/ML, 56.7% of the clinical lab professionals have answered (Yes) while 42.3% answered (No). Moreover, on a scale of ten, the pathologists expressed their trust in the AI/ML results Table 1.

### Attitude regarding AI

Regarding attitude, the survey showed most respondents 58% suspected that using AI may save time and cost (Q4), and 64.1 are worried that AI may replace their jobs in the future (Q5). In contrast, 85.5% agreed that AI can reduce medical errors (Q7), and 92.1% agreed that AI can deliver high-quality data (Q8) Figure 2.

### Subgroup analysis

Subgroup analysis was conducted to evaluate the significant differences in the results according to previous experience of using AL and ML. Questions Q1, Q4 and Q6 showed significant differences Table 3. The Source of variance in question showed significant differences were investigated by *post-hoc* analysis pairwise using Mann-Whitney U tests with Bonferroni adjustment to correct for multiple tests Table 4. The subgroup analysis, Q1, Q4 and Q6 also showed a significant difference between the participants who used AI and those with no previous experience of using AI and ML. This means that clinical lab professionals that dealt showed positive opinion regarding using AI and ML in clinical labs.

Artificial is credited with providing a revolutionized healthcare service (Xiang *et al.*, 2020), it allows achieving tasks efficiently and accurately based on

emulating human intelligence (Lai *et al.*, 2020). Although there is an urgent need for AI tools that assist in disease diagnosis and management (Guo and Li, 2018), the finding of this study showed limited knowledge among clinical lab professionals on AI technologies and awareness of their applications.

More than a third of participants, 42.3% have no previous experience in using AI and ML in clinical laboratories. Quiet similar results were reported in a study performed in Poland where 58% of pathologists have no experience in using AI and ML (Ahmed *et al.*, 2023). These results are consistence with the study performed on 98 healthcare professionals of NHS trust, London as 79% of participants didn't know the difference between machine learning and deep learning (Yu *et al.*, 2018). This limited knowledge translated as resistance to transfer from typical healthcare (McDonald *et al.*, 2017), and discrepancy about responsibility for errors caused by AI tools, especially when there isn't sufficient training on these tools (Hawking, 2014).

Additionally, results showed a significant difference between participants who had previous experience with AI/ML in medical diagnosis and those who had not. Participants with previous experience gave positive responses regarding using AI and ML in clinical labs without replacing their jobs. A consistence results were obtained by Sarwar *et al.*, (2019) showed 75% of participants were interested in applying AI and ML in clinical lab to enhance quality of diagnosis and pathology work. On other hand, 20% were concerned that AI can replace human positions.

Furthermore, 48% of the participants believed that final decision of diagnosis must be for the human physicians, and 25% responded the decision should be shared between physician and AI tools (Sarwar *et al.*, 2019). The current study showed 58% of participants thought that AI can save money, and 82% responded that AI will speed up the process of medical diagnosis. A global study showed that 84%

agreed about the importance of AI and ML in medical diagnosis, and how it will save the cost and time. However, 29.3% expressed their concerns about the ability of the AI algorithm's accuracy in complex and challenging cases. At the same time, 44% thought the AI diagnosis should be considered in the final decision stage over human physicians, while 35.4% expected that AI models would replace their job soon (Oh *et al.*, 2019). A Saudi study included 250 Saudi healthcare providers reported 75% believe AI abilities in medical diagnosis are superior to human experience, while 78% fear that AI could take over their jobs. The study also found that Saudi Arabia's health sector has a potential market that could attract developers and researchers in AI/ML applications in the medical field (Abdullah and Fakieh, 2020).

There is an agreement among clinical lab professionals that AI technologies can change the face of clinical laboratory by reducing costs and improving diagnosis, and quality. The majority of clinical lab professionals in this study agreed that AI could be useful in their work. One of the challenges that limit the implementation of AI technologies in the medical field is the lack of knowledge about it.

In this context, more than a third of participants never used AI applications. Additionally, many of the participants have a concern regarding the effect of AI on their jobs in the future. More resources are required for the planning and applying of AI and ML in the medical laboratories and the training of healthcare professionals for applying AI in their daily practice. Further studies should be done to study the attitude of the community, and the impact of the implementation of AI in the healthcare system and other fields.

The present study has limitations. The first limitation is sample size represent only clinical lab professionals and didn't represent all other healthcare professionals, so in this study couldn't study the effect of the profession on knowledge attitude toward AI technologies. Secondly, the selection bias is due to the small sample size.

**Table.1** Demographic data of the participating pathologists.

Age	38 (28-48)
Years of medical experience	12(10-14)
Sex	Male 66(67.3)
	Female 32 (32.7)
Did you use any AI/ML models before?	Yes 56 (56.7)
	No 42 (42.3)
How much do you trust the AI/ML results in a scale-out of 10?	8(7-9)

**Table.2** Survey validation using Cronbach’s standardized alpha.

Question	Alpha
Q1. I have knowledge about AI or ML in medical diagnosis.	0.779
Q2. AI has valuable applications in the medical field.	0.754
Q3. The diagnostic ability of AI is better than the clinical experience of a human doctor.	0.764
Q4. AI/ML approaches will save time and money for physicians.	0.745
Q5. AI could replace my work in the future.	0.792
Q6. AI can speed up processes in medical diagnosis.	0.756
Q7. AI can help reduce medical errors.	0.733
Q8. AI can deliver much high-quality data in real-time.	0.781
Q9. AI has no space-time limitation.	0.768
Q10. AI could have enough information/algorithms to provide opinions on difficult cases.	0.753
Q11. AI is applicable to every patient.	0.783
Q12. AI is challenging to apply to controversial subjects.	0.817
Q13. AI has a low ability to sympathize with the emotional well-being of the patient.	0.812
Standardized Alpha	0.796

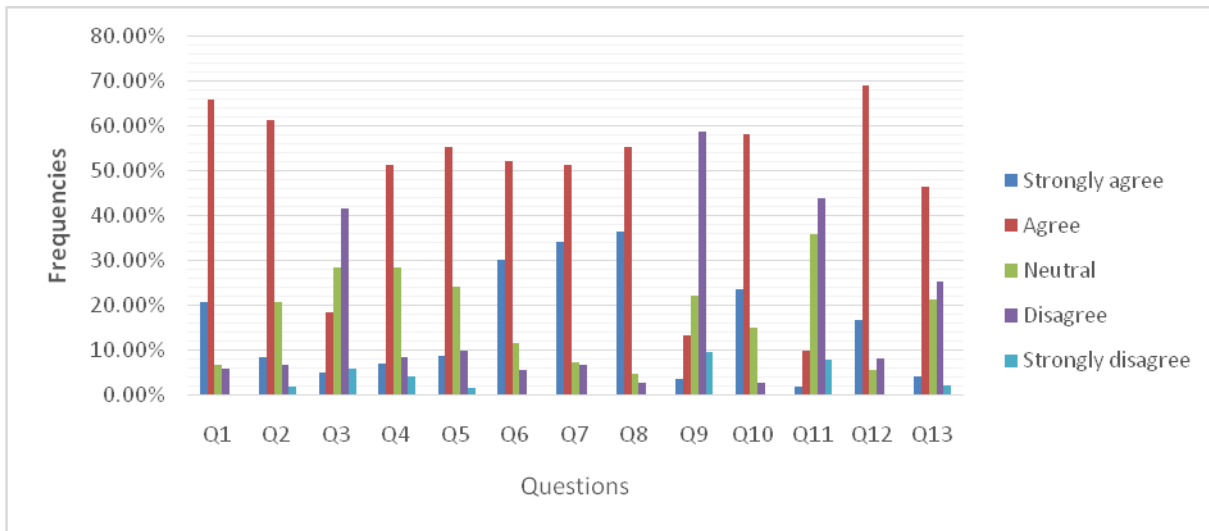
**Table.3** Subgroup analysis by the Kruskal-Walli’s test, P-value was calculated and distributed according to participants’ previous experience in using AI/ML with Bonferroni correction.

Question	P-value
Q1. I have knowledge about AI or ML in medical diagnosis.	0.001
Q2. AI has valuable applications in the medical field.	0.132
Q3. The diagnostic ability of AI is better than the clinical experience of a human doctor.	0.275
Q4. AI/ML approaches will save time and money for physicians.	0.01
Q5. AI could replace my work in the future.	0.879
Q6. AI can speed up processes in medical diagnosis.	0.017
Q7. AI can help reduce medical errors.	0.062
Q8. AI can deliver much high-quality data in real-time.	0.079
Q9. AI has no space-time limitation.	0.32
Q10. AI could have enough information/algorithms to provide opinions on difficult cases.	0.168
Q11. AI is applicable to every patient.	0.13
Q12. AI is challenging to apply to controversial subjects.	0.097
Q13. AI has a low ability to sympathize with the emotional well-being of the patient.	0.076

**Table.4** Post-hoc analysis according to participants' professions and ages.

Question	Post-hoc
Q1. I have knowledge about AI or ML in medical diagnosis.	Significant difference
Q2. AI has valuable applications in the medical field.	No Significant difference
Q3. The diagnostic ability of AI is better than the clinical experience of a human doctor.	No Significant difference
Q4. AI/ML approaches will save time and money for physicians.	Significant difference
Q5. AI could replace my work in the future.	No Significant difference
Q6. AI can speed up processes in medical diagnosis.	Significant difference
Q7. AI can help reduce medical errors.	No Significant difference
Q8. AI can deliver much high-quality data in real-time.	No Significant difference
Q9. AI has no space-time limitation.	No Significant difference
Q10. AI could have enough information/algorithms to provide opinions on difficult cases.	No Significant difference
Q11. AI is applicable to every patient.	No Significant difference
Q12. AI is challenging to apply to controversial subjects.	No Significant difference
Q13. AI has a low ability to sympathize with the emotional well-being of the patient.	No Significant difference

**Fig.1** Reported responses of the survey questions.



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