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Original Paper

Laboratory Employee's Perspective of Artificial Intelligence Application in Clinical Labs

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Abstract

The advancement of the clinical laboratory technology and the emerging of artificial intelligence (AI) has improved the clinical laboratory workflow. AI provided high quality outcomes and reduced cost and time consumed compared to manual test. This study aimed to assess clinical laboratory employee knowledge and attitude toward AI implementation in workplace. An online questionnaire was published online, and responses were collected from 52 laboratory employee including trainee, lab specialist and academic faculty. The results of this study showed that the majority 83% of the respondents believed that the use of AI in clinical labs is important due to its efficiency. 75% of the respondents admitted that the AI would have an impact on hiring in the future as there will be no need for human force to operate these devices. Also most of the respondents feared that AI would replace them in the near future. In addition, most of the respondents were unaware of the AI pros and cons indicating a need for training. To summarize: in order to implement AI in clinical laboratory, employees might need to be more educated regarding to the new technology to evaluate clinical trial opportunities.

Keywords

Artificial intelligence, Clinical laboratory, employee attitude, questionnaire

1. Introduction

The origin of artificial intelligence (AI) can be traced to 1956, when John McCarthy developed the LISP programming language that is associated with data structures, data trees, higher-order functions and dynamic typing to solve problems. Since then, the use of AI has become an essential element of many disciplines (Rajarman, 2014). AI systems are now commonly referred to as 'information

engineering' and defined as the use of computer science to mimic human functions and intelligence, such as learning and decision making (Zahng & Lu, 2021). Recently, AI has become a concern in healthcare, as it has been put into use in several areas, such as clinical practice, biomedical research, public health and health administration (Lekadir et al., 2022). Clinical laboratories have also adopted AI into their workflows; chemistry and haematology were first to use robotics and algorithms in their work (Mennon, 2020).

Technologies such as automation and AI have a great impact on clinical laboratories by aiding them in fulfilling workflow demands during 24/7 operational schedules. Automation technology rearranges the laboratory organisation and staff practices, which in turn increases efficiency; for example, labs can process higher numbers of samples at the same time, increase their output and save time, compared to relying on manual testing. Automation also often reduces costs. AI can lead to the development of new diagnostic methods (Naugler & Church, 2019). Clinical laboratories have recently turned to AI due to its ability to deal with incomplete and imprecise information, provide accurate data, facilitate laboratory workflows, enhance operational decision-making, avoid unnecessary data and alerting for abnormal results (Paranjape et al., 2021).

There are a number of AI applications used in clinical laboratories, especially in microbiology and parasitology labs. Microbiology labs use computer vision to detect some antibiotic bacteria in screening cultures, such as methicillin-resistant *Staphylococcus aureus*. It is also used to detect protozoa in faecal smears and to decrease the time spent examining parasite-free smears in parasitology labs. AI software provides accuracy, precision and limit of detection analysis time (Rhoads, 2020).

Despite its many benefits, AI also has many limitations, such as its high cost, the space consumed by AI devices, the constant need for maintenance, restrictions on infrastructure and the reduced the number of human staff working in AI-enabled facilities (Naugler & Church, 2019). Today, the AI software used in clinical laboratories still needs human effort to perform tasks, but in the future, software may be developed that is capable of achieving high accuracy without expert human review (Rhoads, 2020).

Stakeholders have different opinions on the application of AI in healthcare. Most stakeholders showed a positive attitude regarding AI applications, due to their strong performance and outcomes, but a few reported a negative attitude, due to their misunderstanding of what AI actually means and its effect on ecosystems (Scott et al., 2021). Although AI has been proven highly efficient and capable of yielding quality results in clinical laboratories, it is also associated with changes in laboratories' workforce and increased anxiety and fears of job loss among lab workers (Ardon & Schmidt, 2020). The present study was conducted to evaluate clinical laboratory employees' knowledge of the advantages and disadvantages of AI use in clinical laboratories and to assess their attitudes towards the application of AI in clinical laboratories.

2. Materials and Methods

To assess the benefits and drawbacks of using AI in clinical laboratories, data were collected using a questionnaire. The questionnaire received ethical approved from the ethics committee at Taif University (approval no. 42127), in Saudi Arabia. It consisted of 20 questions divided into four parts (demographics, employee knowledge, employees' opinions and employees' experiences), documented by several questions each. The survey was distributed to the medical laboratory employees and academic staff in the Clinical laboratory sciences (CLS) department at Taif University. The total number of open-ended questions was four, and the total number of close-ended questions was 16.

The questionnaires were randomly pilot-tested on at least 10 respondents, to ensure ease of reading, understanding, methodology and logical ordering and planning. Then, the questionnaires were randomly posted on social media. The average time taken to complete each questionnaire was three minutes, and the total number of respondents was 52.

3. Results

3.1 Sociodemographics

In terms of education level, most respondents held an undergraduate degree or above. Half (50%, n=26) held an undergraduate degree, more than one quarter (28.9%, n=15) held a postgraduate degree and 11 (21.2%) had some other, non-specified, level of education. Regarding their profession, a plurality of the respondents (34.6%) were trainees; 21.2% held an academic postition in a clinical laboratory sciences department at a university; 21.2% were lab specialists in a clinical lab; 15.4% were lab technicians in a clinical lab and others 7.7% were consultants. Regarding their work experience, almost a majority, 44.2% of respondents, had less than one year of experience in a clinical lab, 9.6% of the respondents had worked in a laboratory from 1–5 years, 23.1% had worked in a laboratory for 6–10 years and another 23.1% had worked in a laboratory for more than 10 years. Respondents were also asked in which lab department they work; the responses were as follows: a plurality, 30.8%, work in a medical laboratory, in a department of haematology; 25% work in a clinical chemistry department; 13.5% work in the department of histopathology; 9.6% work in the microbiology department; 9.6% each work in a blood bank and serology department and 7.7% in the department of molecular biology; 3.8% work in the department of parasitology (Table 1).

Table 1. Socio-demographics of Employees

Characteristic	Number	%
Education level		
PhD	12	23.1
MSc	3	5.8
BSc	26	50
Other	11	21.2
Profession		
Consultant	4	7.7
Academic	11	21.2
Physician	0	0
Lab specialist	11	21.2
Lab technician	8	15.4
Trainee	18	34.6
Work experience		
Less than a year	23	44.2
1-5 years	5	9.6
6 – 10 years	12	23.1
+ 10 years	12	23.1
Clinical Laboratory Department		
Clinical Chemistry	13	25
Hematology	16	30.8
Microbiology	5	9.6
Parasitology	2	3.8
Blood bank and Serology	5	9.6
Histopathology	7	13.5
Molecular biology	4	7.7

3.2 Assessing the Advantages and Disadvantages of AI

Respondents were asked if the large, automated machines cause any distractions to their workflow; 27 responded that the machines do not cause a distraction, and 25 said they do. Regarding the advantages of AI, respondents were asked if AI applications provide high quality and specific results on lab tests; 35 admitted they do, while 16 were not sure. Only one denied any advantages. Then, respondents were asked if they think the advantages and disadvantages of AI applications in clinical labs were equal; 15.4% agreed that they are equal, while and 21.2% said they were not. A majority (63.4%) were neutral on the topic (Table 2).

Table 2. Questions that Assess the Advantages and Disadvantages of the AI

Questions		No	%
Do they large automation devices are making some noise, heat and can cause overcrowded staff?	Yes	25	48.1
	No	27	51.9
Does the automated system provides quality and specificity for patients' laboratory testing?	Yes	35	67.3
	No	1	1.9
	Maybe	16	30.8
Generally, the advantages and disadvantages of artificial intelligence applications in clinical laboratories are equal?	Agree	8	15.4
	Neutral	33	63.4
	Disagree	11	21.2

3.3 Assessing Lab Employees' Knowledge and Experiences

Respondents were asked if they thought machine learning methods would give better results than humans' work; 28 agreed that they do, 8 disagreed and 16 were neutral. Respondents were asked if they ever dealt with AI devices; 25 responded that they do, while 27 said they do not. Then, respondents were asked which AI devices they work with. Responses varied among haematology and molecular lab devices. In terms of dealing with AI without complications, 36.5% denied this happened, 23.1% said it is possible and 41.4% were unsure (Table 3).

Table 3. Questions Assessing Lab Employee's Knowledge and Experiences with AI

Questions		No	%
Have you dealt with AI before?	Yes	25	48.1
	No	27	51
Can anyone deal with automation devices' problems or difficulties quickly and without complication?	Yes	12	23.1
	No	19	36.5
	Maybe	21	41.1
Do you think machine learning models would give better results when it comes to predicting the degree of both guide-target interactions and off-target?	Yes	28	53.8
	No	8	15.4
	Maybe	16	30.8

3.4 Employees' Attitudes towards AI

Regarding employees' opinions about the importance of AI's position in clinical labs, 43 agreed that it is important, while only 9 disagreed. Concerning the effect of AI on hiring opportunities, 75% agreed that they are concerned about AI's effects on hiring, while nearly 25% said they were not. When addressing the reasons that could make AI affect employment in the future, many (45.8%) employees feared there would be no need for employees. Then, employees were asked if they think they might be

replaced by AI in the future; 53% think they will still be employed, while 47% think they will be replaced. The respondents think that it is possible to be replaced by AI due to many reasons: 12.5% think staff members will be replaced by AI to save money, 8.2% think that staff will be replaced by AI to reduce the laboratory's costs and effort; 8.2% also think AI will help find reproducible and more accurate results; another 8.2% think people will be replaced because AI is more accurate and faster than manual techniques; 4.1% of respondents think that all the work might one day be done by one person; and another 4.1% think that, because of a click of a button, a group of analyses may be done on a larger number of samples at once. Many others (18.75%) think AI is faster, more efficient and leads to fewer errors. When asked their opinions on keeping AI for use in clinical labs, 67.3% said it is worth using in the lab, while 32.6% did not think so. The reasons why they support AI's use include: It saves effort, time and accuracy in results, it increases the quality of work, improves different things, it is very important for saving time and effort, omits human errors and helps keep up with technological developments. The respondents' opinions on the increasing options of automated systems in the next few years were as follows: a majority, 65.3%, said they expect this, while 34.6% said they do not. When asked about the lack of professional medical laboratory technologists, and if the chief approach to fixing this is automation and process re-engineering, 26.9% of respondents answered no, while 25% of respondents answered yes and 48.1% were not sure (Table 4).

Table 4. Questions Assessing Lab Employee's toward AI

Questions		No	%
AI now has an essential position in the clinical laboratory, and can't dismiss it?	Yes	43	82%
	No	9	17.3
Do you think that the use of AI will affect hiring opportunities in the future?	Yes	39	75
	No	13	25
Do you think lab staff will be replaced by AI?	Yes	23	47
	No	26	53
Is AI worth to be kept in use in clinical laboratories?	Yes	35	67.3
	No	17	32.6
Is it expected that the automated system options would increase over the next few years, along with technological solutions?	Yes	34	65.3
	No	18	34.6
	Maybe	0	0
Do you think that the lack of professional medical laboratory technologists may get worse, and the chief approaches to fix this are automation and process re-engineering?	Yes	13	25
	No	14	26.9
	Maybe	25	48.1

4. Discussion

Artificial intelligence is a collection of technologies that have developed rapidly in recent years, in terms of software algorithms, implementation and application in our daily lives. It has also become an important tool in healthcare, to improve its systems (Bohr & Memarzadeh, 2020). Despite this, there are some concerns about AI in healthcare, such as its possible lack of precision or mistakes that could happen. There also there are some fears that AI could replace human experts (Reddy et al., 2018). This study has highlighted the benefits and drawbacks of using AI, as well as employees' attitudes towards its use in clinical labs.

The results regarding employees' knowledge and experiences with AI revealed that 53.5% believe AI tools give better results for predicting the degree of both target and off-target interactions. Although 48.1% of respondents acknowledged dealing with AI tools in their labs, only 23.1% think it is easy to deal with these devices without complications. These findings are similar to Nguyen and Malik's 2021 study, which showed that higher quality AI systems have a great impact on employees' service quality.

Regarding the advantages and disadvantages of AI use in clinical labs, from employees' perspectives, 51.9% believe that AI does not bring about disadvantages such as noise, heat or causing staff overcrowding in the workspace. Most (67.3%) of the participants believe that AI applications in clinical labs are able to provide quality and specificity for patients' laboratory tests. Only 15.4% of the participants agreed that the advantages and disadvantages of AI applications are equal in clinical labs, while only 21.2% disagreed. A majority (63.4%) were neutral on the topic. These results were similar to the study conducted by Ardon and Schmidt (2020), which showed that laboratory staff confirmed that AI can reduce errors and increase efficiency, but they also had some concerns regarding AI's performance in tasks that required judgment and assessment.

Regarding clinical laboratory employees' perspectives on AI, the results were as follows. A majority (75%) believe that AI will affect hiring opportunities in the future. Most of their concerns were due to the use of AI software, which may only need a minimum number of humans, and some think that AI will facilitate lab work with a minimum of mistakes and reduce the time required to complete tasks, compared to manual techniques, when large numbers of samples are being tested. Interestingly, 44.2% of the respondents believe that lab staff will be replaced by AI. Their concerns stemmed from the belief that AI is more efficient, reduces costs and saves money. A study by Tschang and Almirall (2021) showed that some organisations are now using AI to perform routine work, while humans are performing non-routine and low-skilled work, which might allow for their replacement in the future. Laboratory employees have a positive attitude towards the adoption of AI, but they also have some concerns, such as a fear of losing their jobs.

5. Conclusion

The need of artificial intelligent set is growing in many life aspects and healthcare is one of them. The use of AI application in clinical laboratories facilitate the lab work as it has been proven that it provided

a high-quality results, and saving time and costs. However, the lab employees agreed with the benefits of AI sets in the clinical laboratory, it also increase their concerns regarding to their future whether they might lose their job or decrease the hiring laboratory specialist. The results offered the opportunity to evaluate pros and cons also take the ethical issue of using AI in clinical labs into considerations. Education and knowledge of the employee regarding to the new technologies are necessary in order to evaluate clinical trial opportunities.

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Author contributions

Ashjan Shami conceptualized the study, wrote the manuscript, and analyzed the data.

Conflict of interest

The author declares that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

Statement of Informed Consent

The respondents had the option to withdraw from the study at any time and offered their responses without being coerced.

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