

Artificial Intelligence in Laboratory Medicine: Current and Future

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Abstract

Objectives: Health care sector continues to undergo digitalization and automation. Clinical laboratories likely to face the challenges associated with machine learning and artificial intelligence. Understanding what AI is good for, how to evaluate it, what are its limitations and how it can be implemented are still not well understood. With a survey, circulated through the google forms, we aimed to evaluate the thoughts of stakeholders in laboratory medicine on the value of AI in the diagnostics space and identify anticipated challenges and solutions to introducing AI.

Methods: We conducted a survey in the form of few questionnaires in the Google form, circulated amongst the lab personnel and their responses are recorded. And further statistically analyzed.

Results: In total, 83 people responded in the google form survey.

Education in the value of AI, streamlined implementation and integration into existing workflows, and research to prove clinical utility were identified as solutions needed to mainstream AI in laboratory medicine.

In our survey, 95.2 % are with positive attitude in accepting AI and educate themselves to know and update themselves to newer technology. Among them, 68.7 % are ready to implement AI in their workplace. But 45.8 % say, they do not have enough resources to implement AI.

Conclusions: This survey demonstrates that specific knowledge of AI in the medical community is poor and that AI education is much needed. One strategy could be to implement new AI tools alongside existing tools.

Keywords: AI- artificial Intelligence, MI- Machine Learning

Introduction

Machine learning is an umbrella term for diverse computational methods by which machines can incrementally build an accurate data model according to

a measure of how well the model supports a given task, which in medicine is usually of discriminative nature, i.e., Classification or clustering³. Machine learning (ML) is routinely used in biochemical development and for evaluating and interpreting data in genomics, transcriptomics and proteomics pathways whereas in clinical laboratory medicine, it has been applied to classical biomarker testing of biological materials. Designed to evaluate specific data in hematology, urinalysis or clinical chemistry, they are traditionally based on a predefined decision tree encompassing logic rules and checks to exclude diagnostic hypotheses or define them or suggest further analysis to complete the diagnosis and support decision making³.

As laboratory medicine continues to grow in digitalization and automation, laboratory physicians will likely be confronted with the challenges associated with evaluating, implementing, and validating AI algorithms, both inside and outside their laboratories. Understanding what AI is good for and where it can be applied, along with the state-of-the-art and limitations, will be useful to practising laboratory professionals and clinicians. On the other hand, the introduction of new technologies requires willingness to change the current structure and mindset toward these technologies, which are not always well understood¹. Today, AI is occasionally used in laboratory medicine for enabling the effective use of resources, avoiding unnecessary tests, improving patient safety, and alerting for abnormal results^{4,5}. AI is also being used in limited clinical usage for molecular/genomic testing^{6,7} by accurately identifying variants and matching it to possible treatments¹.

Historically, there has been resistance to the adoption of new technologies in the medical community⁸. The following pic depicts how the evolution of man took place and how man has evolved himself to ML and AI in

the modern era. And man has become the slave to the machines!

Materials and Methods

Survey Development: A web-based survey on the use of AI in laboratory medicine was designed in several independent step. We conducted a survey in the form of few questionnaires in the Google form, circulated amongst the lab personnel and their responses are recorded. And further statistically analyzed.

Finally, as there are multiple different definitions of AI, for the sake of the survey we defined AI as follows: “Artificial intelligence (AI) in health care is the use of complex algorithms and software to emulate human cognition in the analysis of complicated medical data generated from diagnostics, medical records, claims, clinical trials, and so on. AI is truly the ability for computer algorithms to approximate conclusions without direct human input.”

Questions

In the survey, we posted few questions that ranged from collecting demographic information to answering questions about if the respondents used AI in their organizations, what kind of improvements they would like to see in the current use of AI, how valuable they think AI will be in their practice, and what challenges they feel exist.

Data Analysis

Quantitative Data: Categorical data were analyzed using a Pearson χ^2 test, considering a P value less than .05 to be statistically significant. The analyses were performed in Microsoft Excel. Data from the multiple-choice questions were presented as percentages per category.

Results

Qualitative Analysis: Based on the data, six main themes were derived (attitude, quality of care,

organizational value, data analysis, prerequisites, and education). The “attitude” theme was further categorized into three subthemes (positive, unsure, and negative).

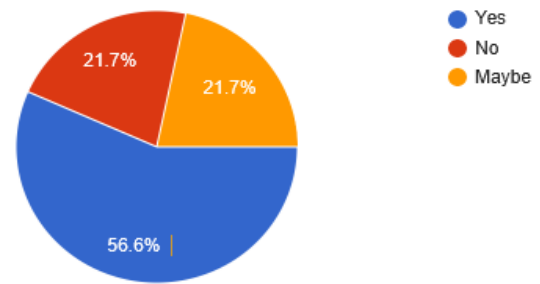
Discussion

With this survey of AI, we aimed to evaluate the thoughts of stakeholders in laboratory medicine on the value of AI in the diagnosis of the patient and identify anticipated challenges they face in their profession with the introduction of AI in this field.

All surveys on this subject in the medical community seem to show similar results regarding the perceived value of AI with AI in clinical practice. The fact that these results also overlap with the value of AI as perceived by the general population.

Knowledge about AI

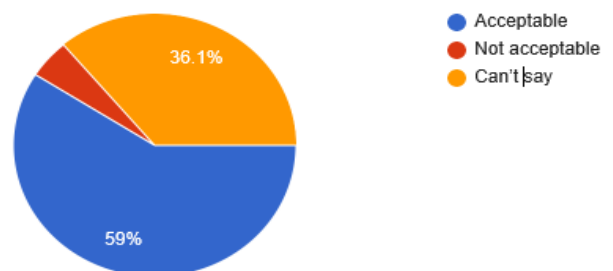
In the modern era, as the laboratory medicine continues to undergo digitalization and automation, clinical laboratorians will likely be confronted with the challenges associated with evaluating, implementing, and validating AI algorithms, both inside and outside their laboratories. Understanding what AI is good for and where it can be applied, along with the state-of-the-art and limitations, will be useful to practicing laboratory professionals and clinicians. On the other hand, the introduction of new technologies requires willingness to change the current structure and mindset toward these technologies, which are not always well understood. Among the 83 responders, 56.6 % have basic knowledge about AI. Another 21.7 % have no idea about newer technology AI. Rest others, have little or less knowledge of AI.



Attitude and AI

Attitude can be barely considered as sentimental in the current theme. The attitude of an individual about any approach is purely subjective. It depends on knowledge of the person, exposure of the person and how he is flexible to accommodate the changes and challenges given to him.

We received 82 responses in total in our survey. Out of which 59% of the people had acceptance to implementing AI or in other words, they had positive approach towards bringing out changes in them towards AI and ready to face any challenges incurring in the meantime. 36.1 % were in dilemma - not sure about themselves that weather they can accept the changes and face the challenges??? 4% of the respondents said, AI is unacceptable to them...

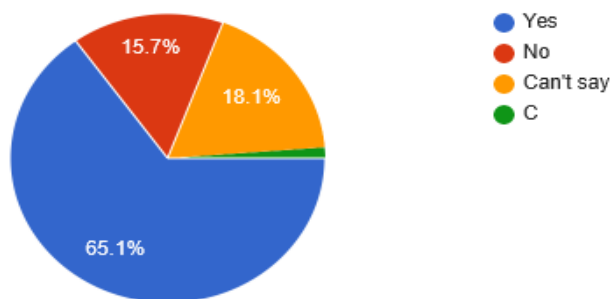


Usefulness of AI at the work place

AI is considered to be useful in the health sector. AI may may have some useful clinical algorithms to identify problems before they are known by the humans, but technology is still in early development. AI is helpful in the early diagnosis of the disease so that treatment can be started early and patient could get better care. With AI,

the turnaround time for any investigations is reduced. It would make the more efficient by streaming the workflow. It also may help by keeping the patient informed of the test results/ appointments/ and follow-ups in the more efficient way.

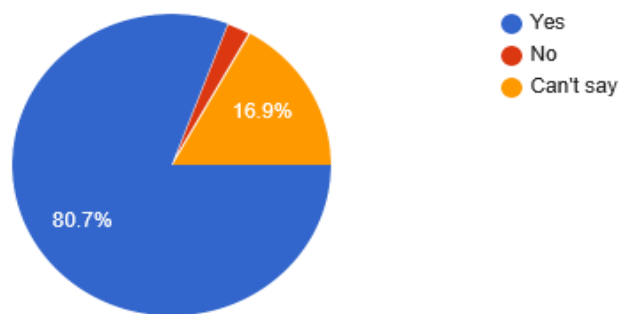
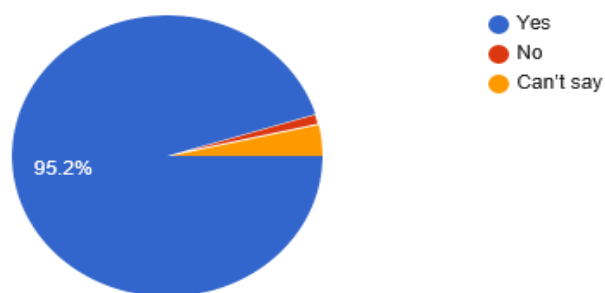
Out of 82 responses we received, 65.1 % people said AI is useful in their professional workplace. 15.7 % people said, that it is no role in their workplace. 18.1 % are unable to decide its usefulness in their workplace.



Educating and awareness about AI

The people in the health sector have positive attitude about themselves about inculcating newer technology in them. They are happy to learn more and update themselves.

Among the 82 responses received, 95.5 % are ready to educate themselves to know more about AI. 80.7 % are ready to spread awareness about AI to the other people. 68.7 % are ready to take initiative to implement the AI in their workplace. 24.1 % of the people are in dilemma whether they could implement AI in the work place or not.

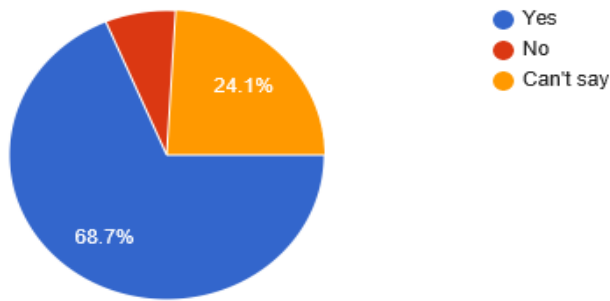


Implementation Strategies

In this survey, 24.1 % of respondents did not see the added value of implementing AI in laboratory medicine, partially because of the high initial investment costs. Whereas, 68.7 % said, they can implement the AI in their workplace.

While discussing about the resources to implement AI, 45.8% said, they do not have enough resources in their institutional set up to implement AI. 34.9 % are not sure whether the resources they have will suffice the implementation of AI.

The availability of the resources is the limiting factor as long as the return on investment and clinical benefits of these tools are not well understood. A recent narrative review on the clinical applications of AI for sepsis validates this idea by identifying that a large gap still remains between the development of AI algorithms and their clinical implementation.³² The question remains whether this gap between development and clinical implementation might be caused by the resistance to implementing new technologies. Unfortunately, this can hold back research on this subject and thereby delay the gathering of evidence on whether AI tools can be beneficial and cost-effective in clinical practice on a large scale.

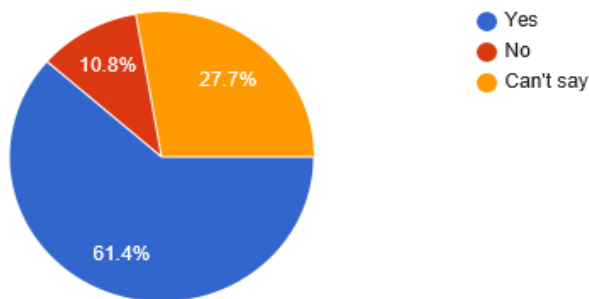


Health Care Costs

Another highlight from this survey was the potential of AI to target high health care expenditure, since it can reduce and replace repetitive manual labor. Recent study has shown that AI can help reduce the waste in the US health care system in the range from \$760 billion to \$935 billion in 2019.³⁰

For Ex: When the patient gives his blood sample for testing, we can safely reduce the number of laboratory tests ordered or the frequency of ordering the repeat tests. With the help of this we can make ease and convenient for the population and reduce the health care related miscellaneous cost to patient. And also, with the help of AI we can get the information / updates about the reports with the help of AI by saying “Alert me to the fact that a lab test I ordered was already completed at hospital system in the past week.

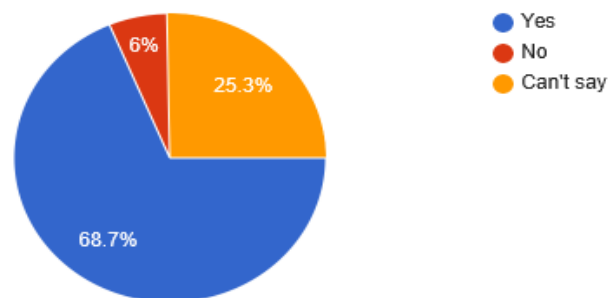
In our survey, we got 82 responses. 52.3 % said they have the basic knowledge of usage of AI. 22% have no knowledge of AI and 22.7 % may or may not have knowledge of AI which they are not sure.



Impact on jobs

“AI will become an integral concept for health care. Whether diagnosis or process improvement in medicine, AI will impact the industry. For personalized medicine and improving diagnostic accuracy AI will drive decision making in the hands of providers,” which is an executive at a large integrated health network. In the similar way, Laboratory managers think that AI could create efficiencies that expedite their workflows but want to ensure that they are still in control. “AI needs to be used in the right spaces and not to eliminate medical technicians but to supplement them.”

Among the 82 responses we received, 68.3% of the people said, AI will replace the jobs in future in their profession. 21.5 % of the people are still in dilemma whether AI will replace their jobs or no. About 5 % of the people said, Ai cannot replace their jobs. Recent studies say that, even though AI is very strong technology, it cannot be a competent to human brain!



Strengths of the Survey

In our survey, we addressed a target population of participants who are currently in a position to influence organizational policies to either embrace new technologies or refrain From using them in their laboratories. Any specific intervention to encourage the introduction of AI in the diagnostics space should be tailored to such a population of decision makers.

Limitations of the Survey

The participants did not represent the entire population of practitioners who will be using AI in a diagnostic setting. We cannot generalize these findings to all laboratory medicine practitioners across multiple types of settings.

Conclusions

The potential application of Machine Learning models to laboratory.

Data is relevant but not yet fully realized. Although it is reasonable to expect that as ML methods become better known they will be applied to reduce costs, support clinical.

Decision making and improve outcomes; we also advocate for further research to address the main obstacles to a wider adoption and exploitation of these method in laboratory medicine.

This survey shows that many respondents in laboratory medicine think that AI will be valuable to them in the near future, mostly given the “organizational value” and expected improvements in “quality of care,” although vital prerequisites such as support systems, strategic plans, and budgets need to be provided. The overall response to this and other similar surveys raises the concern that specific knowledge on AI in the medical community at large is still poor. AI education in the medical community is much needed.

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