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Artificial Intelligence Can Boost Reliability and Speed of Medical Imaging Analysis in Clinical Trials

Artificial Intelligence Can Boost Reliability and Speed of Medical Imaging Analysis in Clinical Trials

Pharmaceutical firms face many challenges in bringing their products through clinical trials — from enrollment delays to data quality issues — and every advantage can make a difference.

In image analysis, sponsors can gain a critical advantage by leveraging artificial intelligence (AI) or machine learning (ML) — computer solutions that mimic human intelligence and are continually enhanced and updated to become more accurate as they take in more data. One subset of machine learning, known as deep learning or convoluted neural networks, offers high accuracy in image recognition and has applications for medical image analysis and interpretation.[1,2] For example, in liver and spleen volume measurement, AI and ML allow rapid and efficient assessment of every slice of an image series.[3] They also can aid in more accurate identification, classification and measurement of tumors.[4]

These benefits are particularly pronounced for medical imaging in clinical trials, where eligibility decisions and efficacy evaluations can be accelerated, and data accuracy and quality improved. AI can reduce variability in imaging endpoints, enhance the reliability of those endpoints for use in statistical models of efficacy and safety, and reduce the cost of providing quantitative endpoints for a trial.[5]

In the fast-paced clinical trial arena, time is crucial as sponsors aim to get their product candidates in front of regulators before the competition. Improved data accuracy and quality means companies present cleaner, more consistent data to regulatory authorities, improving their chances of trial success and approval.[6]

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Benefits for Medical Imaging in Clinical Trials

In clinical trials with medical imaging endpoints, AI solutions are designed to make the central review of images faster, more accurate and more consistent.[7] The need for this technology will only grow as imaging becomes increasingly complex and requires additional expertise.

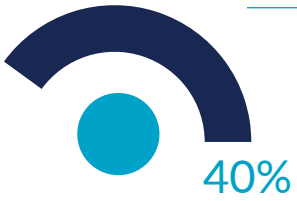
The Medpace Core Lab is already a leader in the use of ML algorithms for medical imaging assessments in multiple areas, including:

- Detection of lesions and infarcts in brain scans.
- Measurement of liver and spleen volume in metabolic disease, with the ability to review every slice of a specimen.
- Scoring of liver biopsy specimens using the NASH Activity Score.
- Identification, classification and measurement of tumors.

Leveraging AI in a Clinical Trial Will:

Boost speed. AI allows automatic interpretation of images, such as the ability to quickly assess images against eligibility criteria for a trial. This can cut turnaround time from days to milliseconds and shave weeks or months off the timeline for patient enrollment. This time is key to trial success, as 86% of trials miss their enrollment deadlines and participant selection is frequently the cause of trial delays.[1]

Improve quality of images and interpretations. AI soon may be able to identify medically relevant findings, as well as poor quality medical images, helping radiologists avoid missed lesions, misclassifications and flawed measurements. These issues can compromise the integrity of trial findings and patient health.



Ensure consistency. Without AI, sponsors see up to 40% variability on different radiologists' readings of scans, as well as significant variability in the same radiologist's interpretation of the same scan on different occasions.[8] Variability with ML is significantly better and can be virtually eliminated with more and better training of the algorithm.[2]

Beyond Conventional Medical Imaging and Radiology

AI applications for additional types of medical imaging include:

- **Longitudinal measurement** of abdominal organ volumes from cross-sectional CT and MR images done automatically with no manual interactions, resulting in highly repeatable measurements that allow small changes to be identified in response to treatment.
- **Pathology.** AI can automate pathology classification (e.g. NAS) and survey a larger portion of biopsy specimens in a fraction of the time needed by a pathologist to look at a single slide and with greater reliability.[5,9,10]
- **Neuroscience.** Neurological disorders are associated with changes in brain structure and volumes, and ML can automatically measure changes in these regions within milliseconds to show neuroradiologists whether a drug is slowing disease progression.[4]

Barriers to Uptake

Despite the clear benefits of ML in medical imaging, only about 10% of clinical trials managed by contract research organizations are using the technology for managing eligibility decisions or final imaging endpoints.[11]

"One reason for that is AI solutions published in the scientific literature have not been trained and validated with adequate datasets and images, which can compromise their performance," says Dr. Scott Holland, Director of the Imaging Core Laboratory at Medpace. "Training is key to the success of an ML algorithm, and proper training requires hundreds or even thousands of training and validation images that have been reviewed and labeled by experts," he adds. "Medpace Core Labs has access to thousands of high-quality images for training and validation, and uses them to train ML algorithms to make different types of assessments," Holland notes.

Uptake is further challenged by lack of integration with radiologists' existing workflows. Images must be automatically submitted to the AI solution, with relevant findings flagged, before they go to the radiologist, says Dan Braga, Vice President of Product Management for Medical Imaging Solutions at Medidata Solutions.

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>
> **DR. SCOTT HOLLAND,**
> Director of the Imaging Core Laboratory at Medpace

"It won't work if the radiologist needs to log into a different system," Braga says. "The AI needs to plug in behind the scenes and provide the information to radiologists at the time of the imaging review, within the platform they are already using to review images."

To make AI easier for sponsors to integrate with their trials, Medpace Core Labs has an integrated quantitative image analysis pipeline directly built into the clinical trial workflow and data management system. This streamlines the process for investigators, radiologists and central reviewers, allowing AI approaches to provide preliminary measures that are ready for central review.

Medpace has partnered with Medidata to integrate imaging and clinical data into a single platform, allowing immediate availability of high-quality imaging endpoints in the study database. Medidata's Rave Imaging provides image management support for a wide range of the clinical trial market, with a familiar sponsor-facing pipeline to upload images to the web portal, while the Medpace Core Lab adds quantitative analysis capabilities. Sponsors also have access to support from Medpace imaging scientists with expertise in areas ranging from CT/MRI-based RECIST measurements to liver fat fraction measurement and brain image segmentation.

This makes it easier for sponsors to define eligibility, monitor disease progression or response, make decisions and provide quantitative endpoints.

The Future of AI Imaging in Clinical Trials

As more sites and sponsors adopt AI solutions, they will begin to reshape the trial process. Enrollment will be expedited, with faster eligibility decisions and cleaner, more accurate data.

Sponsors will see less bias, both during the enrollment phase, when investigators working for a sponsor may be predisposed to enroll patients in a trial, and during subsequent phases, when knowledge of a patient's family or medical history could influence investigator perception.

Greater adoption of AI solutions in trials also will bring the automation of some imaging endpoints. The FDA has created a framework for integration AI/ML into software used as medical devices.[12] This regulatory framework will guide implementation of AI in medical imaging.[13] For the time being, imaging endpoints will be reviewed and approved by trained central readers who have appropriate credentials and certification.[14]

Finally, significant cost savings will come from relieving imaging technologists and radiologists from having to perform tedious, time-sensitive measurements by implementing automation of preliminary analyses.

Finding the Right Solution

"Although the clinical trial industry has been slow to adopt AI, these technologies are here and are already being used to revolutionize clinical radiology and other business sectors," Braga says.

Sponsors that are considering the next step should first determine how a solution partner has validated its ML algorithms, including the datasets used, the size of those datasets and whether the validation dataset had ground-truth data — i.e., an answer key that has been read by a radiologist.

"The solution should also be easy to integrate with existing workflows for blinded independent image review and customizable for the specific needs of a trial," says Andrea Falkoff, Director of Clinical Imaging Delivery for Medidata Solutions. For example, Rave Imaging has sites around the world submitting images, "which makes it very easy for us to overlay an AI algorithm within whatever step of the workflow we need to," Falkoff says.

The right solution and partner will save sponsors money; allow central reviewers to work more efficiently and provide better, more accurate results; and enable sponsors to develop therapies faster for patients who need them.

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