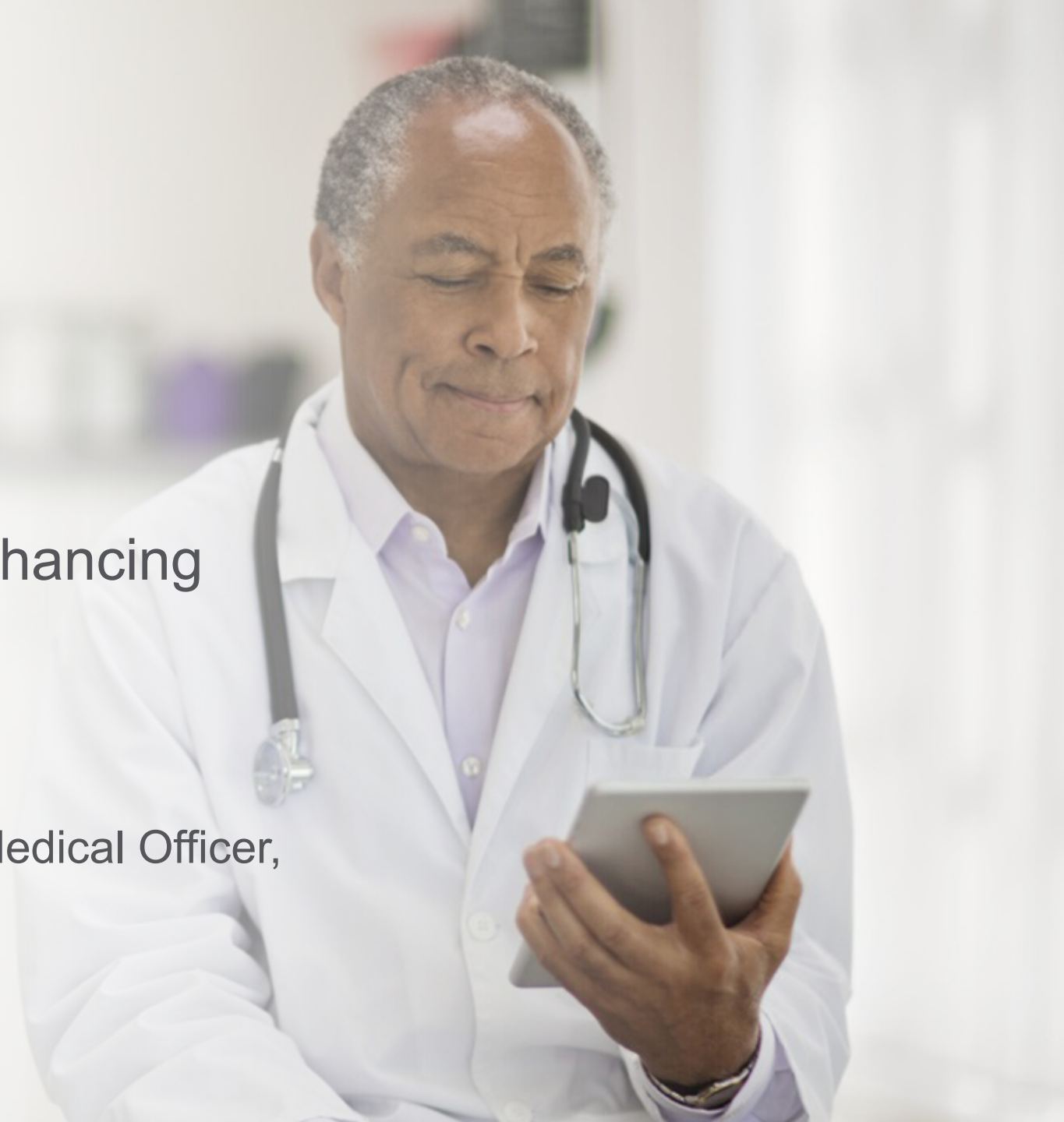
Case in point: AI & diagnostic imaging

Role of artificial intelligence in enhancing clinical quality and efficiency



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OPTUM Labs®

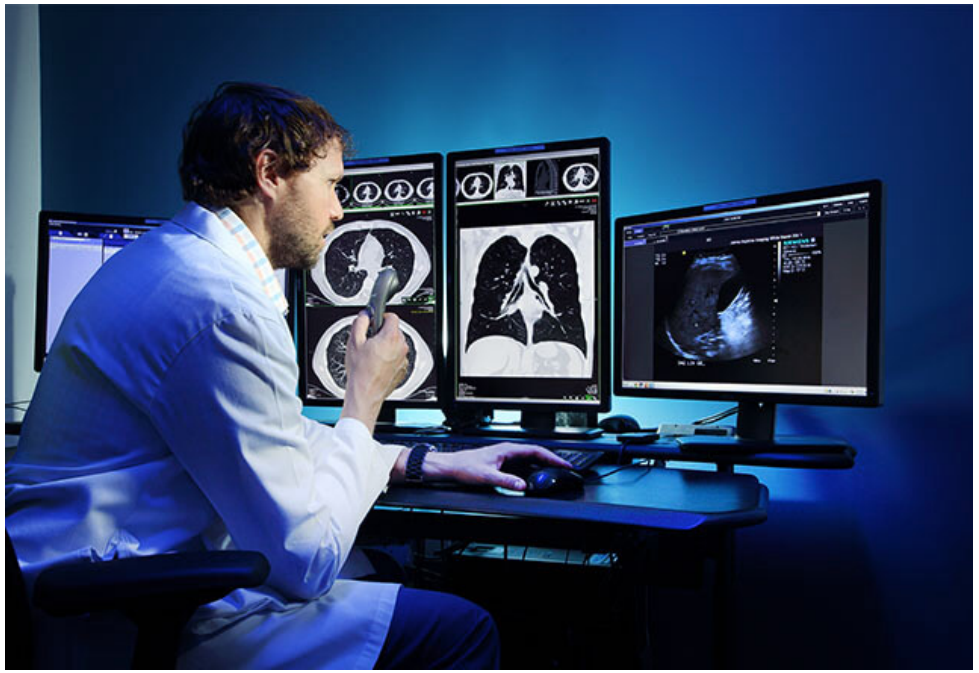
Disclosures

Financial Disclosures:

- None

Diagnostic imaging – what is a radiologist?

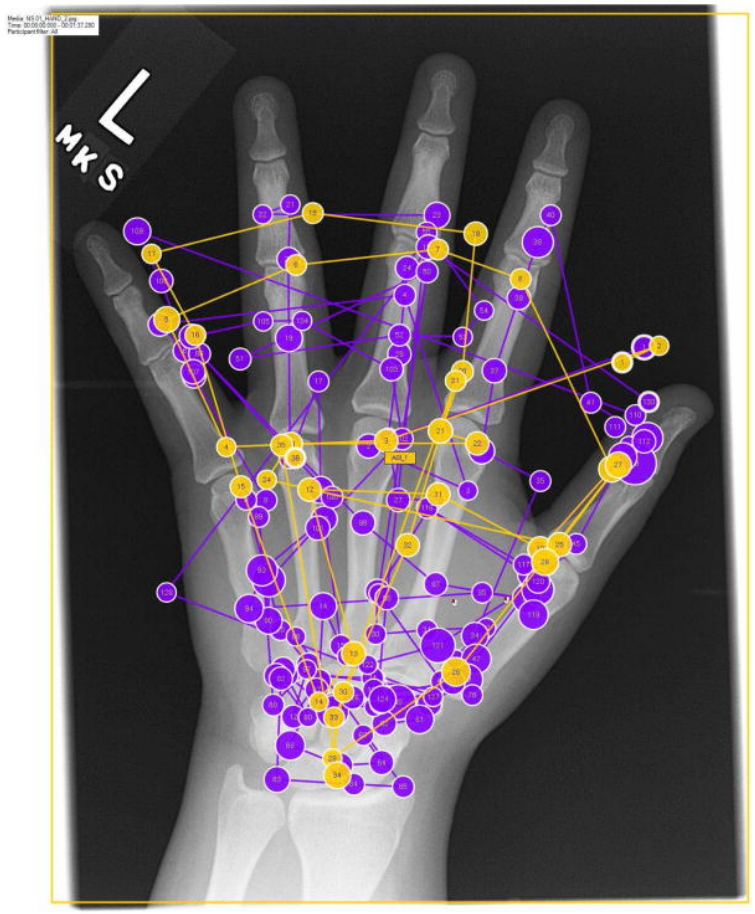
Radiologists are medical doctors that specialize in diagnosing and treating injuries and diseases using medical imaging (radiology) procedures (exams/tests) such as X-rays, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine, positron emission tomography (PET) and ultrasound.

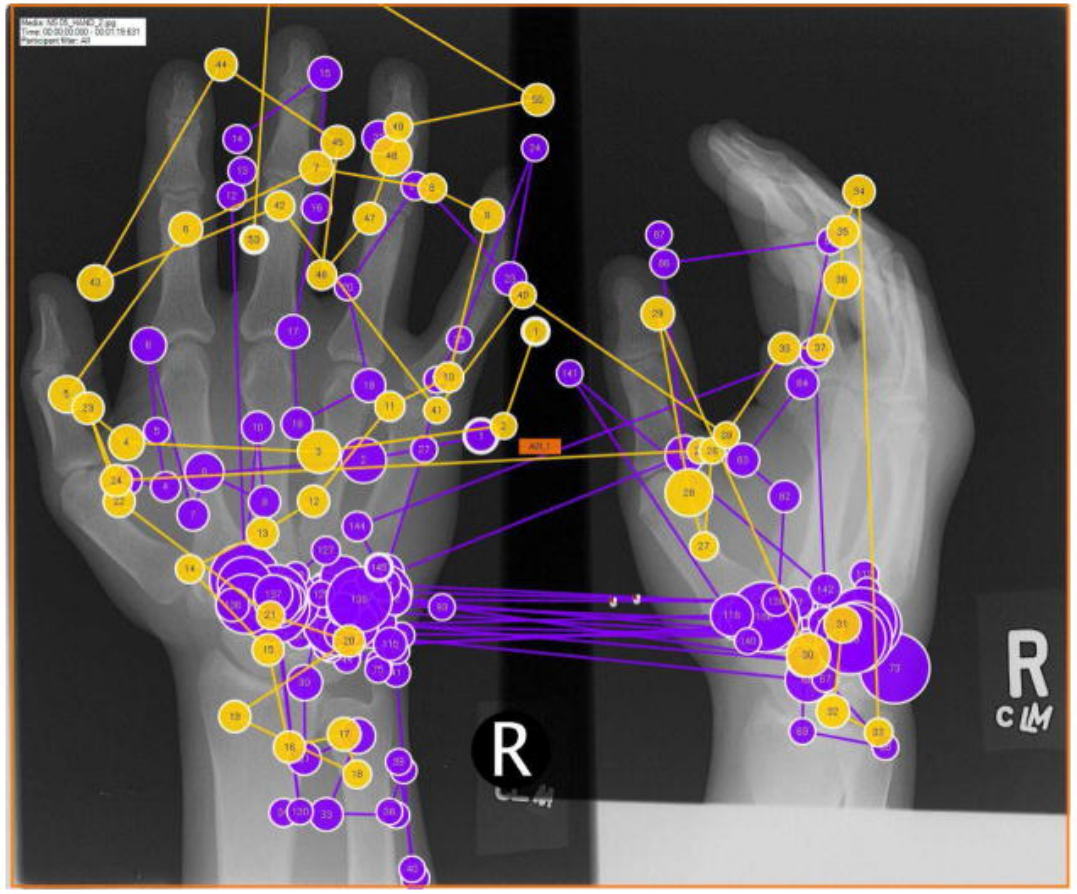


X-Ray lightboxes

Digital workflows – PACS (picture archiving and communication system) workstation

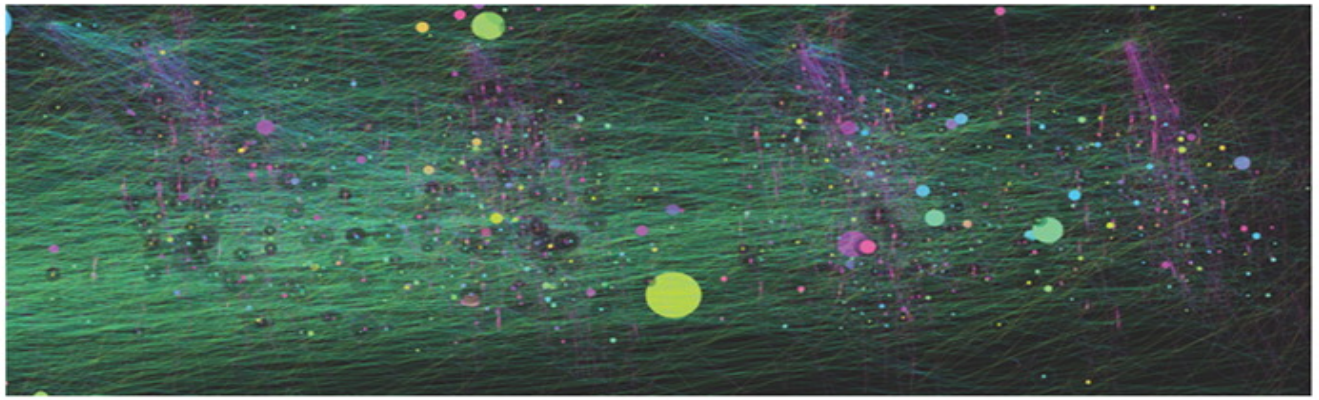
Visual search fatigue and variability





Tarek Hanna, et al. *JACR*. 2018.

Radiologist Mouse Movements at a PACS Workstation



Tracked movements on a PACS workstation with two monitors.

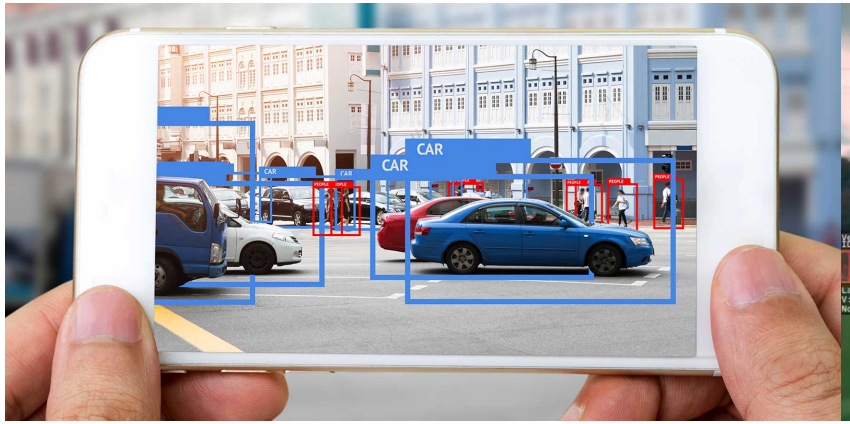
The mouse movements and mouse stops performed by a radiology resident at a PACS workstation were tracked during an 8-hour shift. Line coloration indicates movement orientation (vertical [pink], horizontal [green], and oblique [orange and purple]) and mouse stops (colored circles).

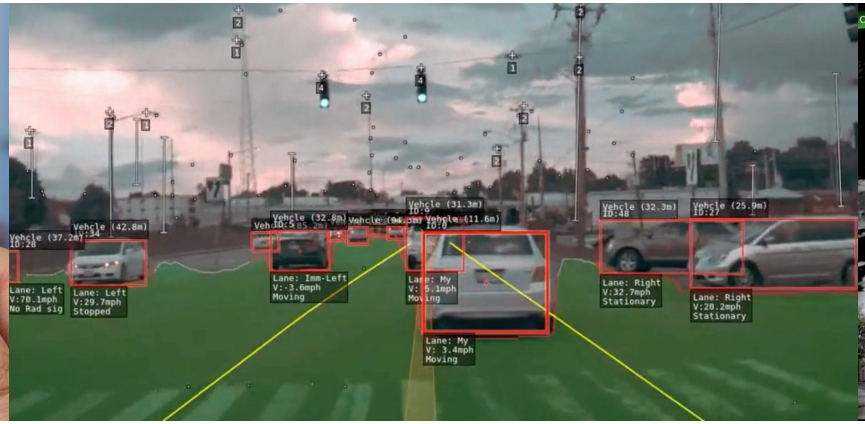
The mouse activity added up to a distance of 2.2 km (1.37 miles) and 10778 keystrokes (23 keystrokes per minute).

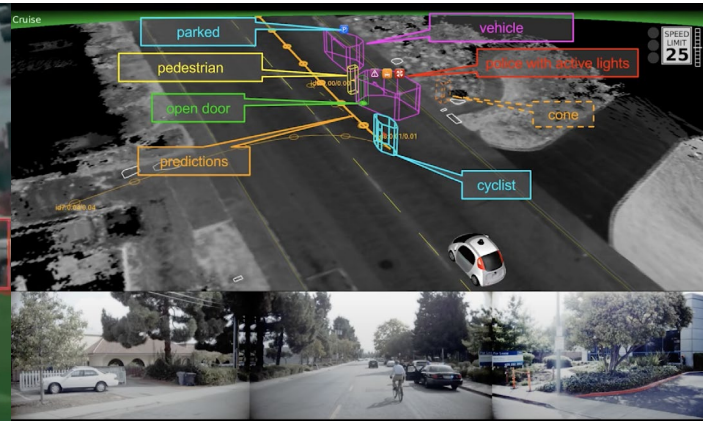
Vosshenrich and Breit. Published Online: February 16, 2021
https://doi.org/10.1148/radiol.2021203469

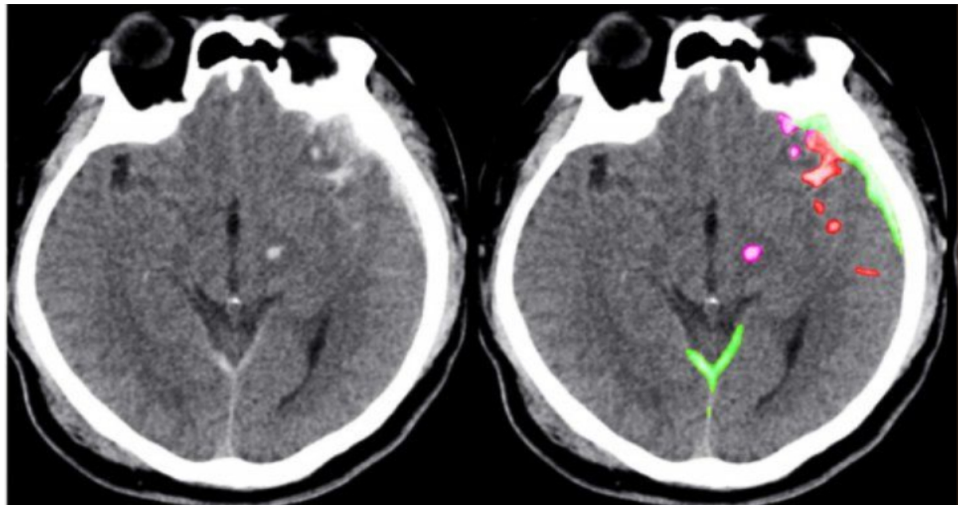
Radiology

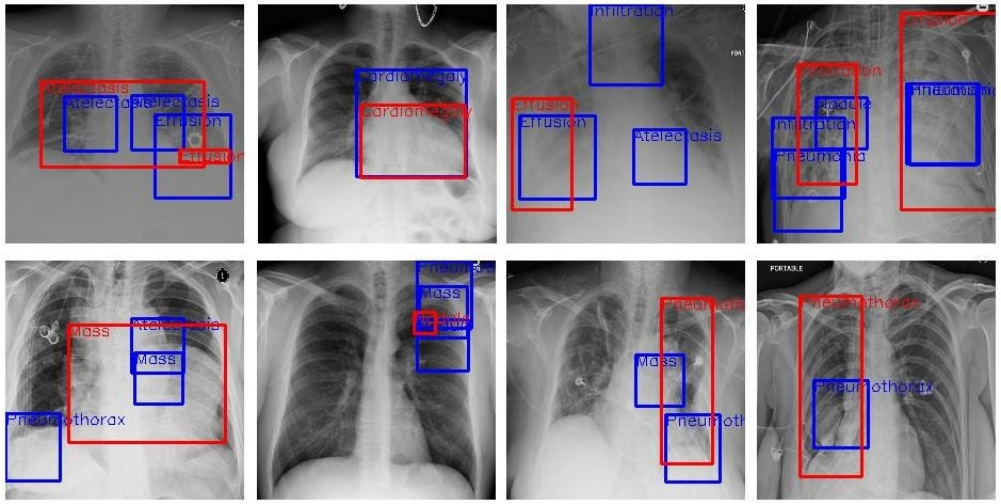
Computer vision in the real world



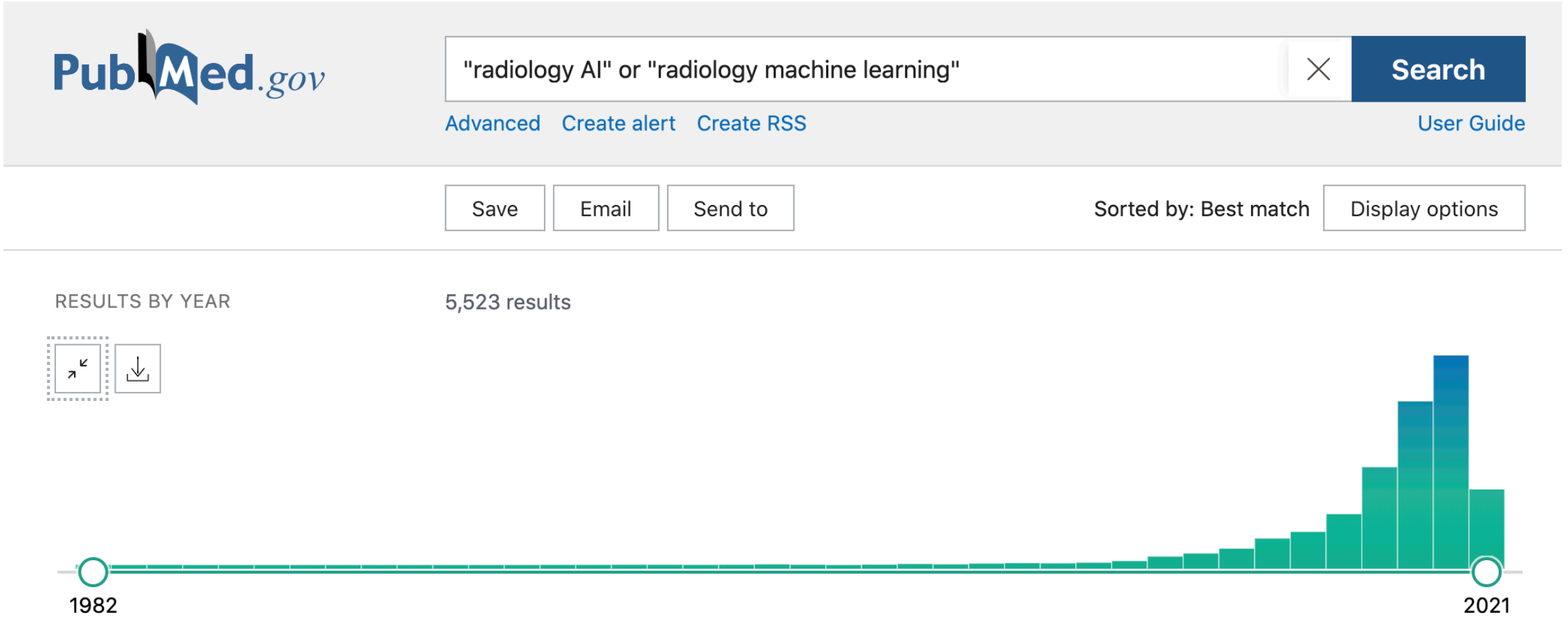








Rapid research and development in medical imaging



Current Applications and Future Impact of Machine Learning in Radiology

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Conflicts of interest are listed at the end of this article.

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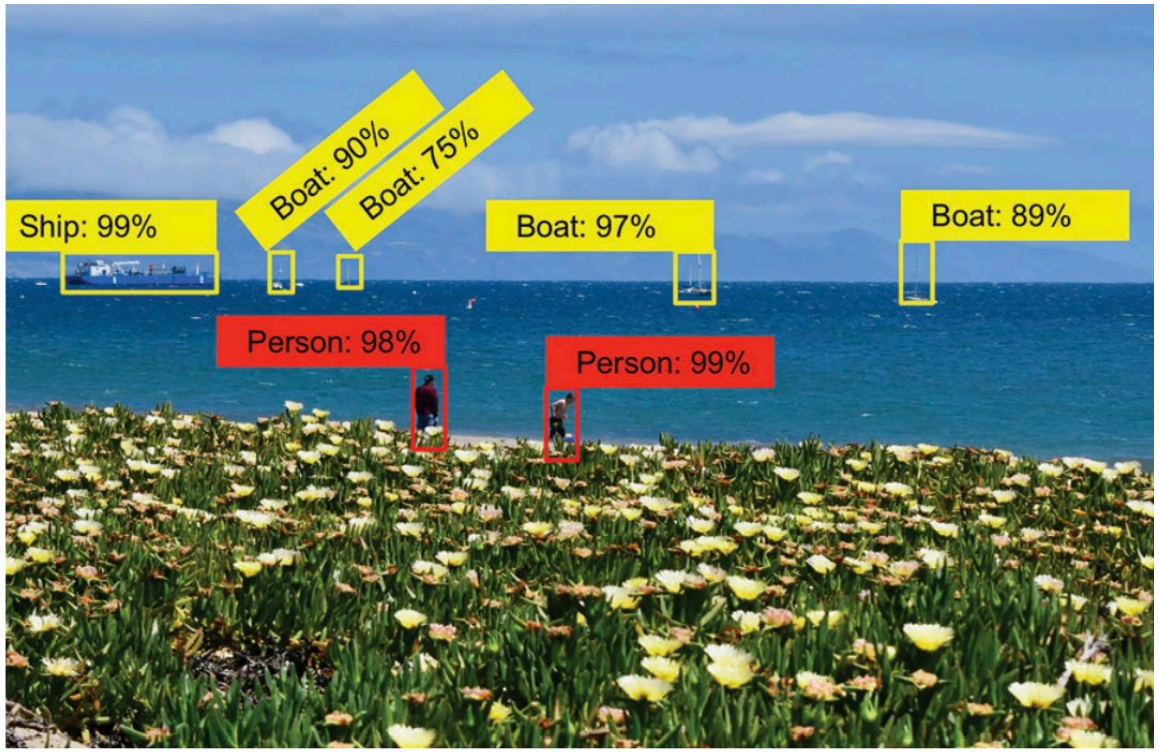
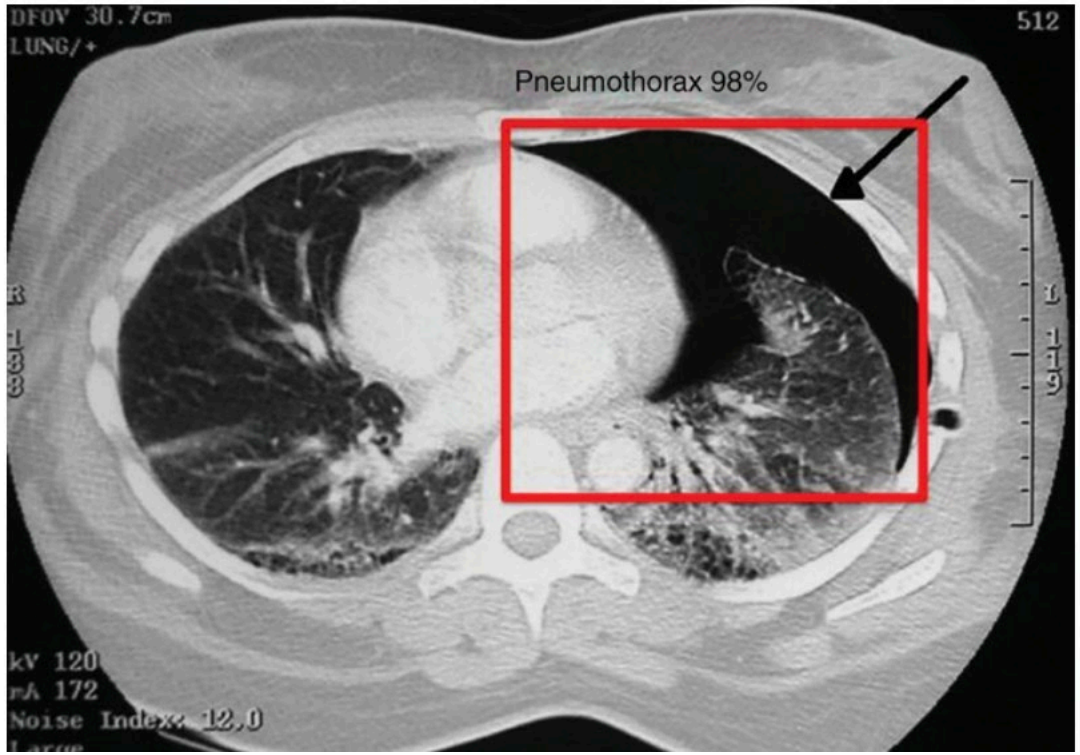
Recent advances and future perspectives of machine learning techniques offer promising applications in medical imaging. Machine learning has the potential to improve different steps of the radiology workflow including order scheduling and triage, clinical decision support systems, detection and interpretation of findings, postprocessing and dose estimation, examination quality control, and radiology reporting. In this article, the authors review examples of current applications of machine learning and artificial intelligence techniques in diagnostic radiology. In addition, the future impact and natural extension of these techniques in radiology practice are discussed.

Clinical applications of machine learning in radiology

Order scheduling and patient screening
Automated clinical decision support and examination protocoling
Image acquisition
Automated detection of findings and features
Automated interpretation of findings
Image management, display and archiving (eg, picture archiving and communication systems)
Postprocessing: image segmentation, registration, and quantification
Image quality analytics
Automated dose estimation
Radiology reporting and analytics
Automated correlation and integration of medical imaging data with other data sources

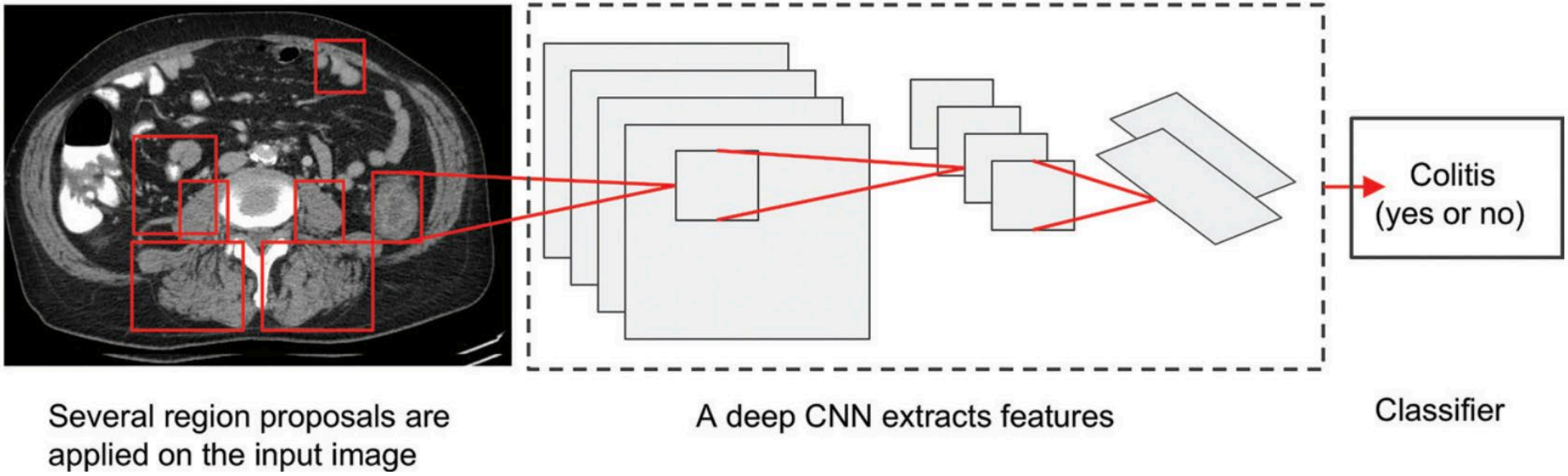
Findings detection & classification: pneumothorax





Feature extraction example in medical imaging use case. Automated detection of critical findings such as pneumothorax in medical imaging is one application of machine learning. Heads-up display or method of highlighting relevant findings in a picture archiving and communication system or other image viewing system is example of how machine learning can be productized and integrated into radiology workflow.

Findings detection & classification: colitis on CT



Example: Deep convolutional neural network (CNN) system for detection of colitis.

- In the first step, several thousand automated regions are applied on each CT section with an algorithm that finds all possible places where objects can be located (region proposal).
- For each region proposal, feature extraction and computation are performed by implementation of CNN with multiple hidden layers by using pretrained data sets.
- In the last step, classifier algorithm (eg, linear support vector machine) could be used for colitis classification.

Blind spots: challenging diagnoses and common missed findings

Radiology: Artificial Intelligence

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Original Research

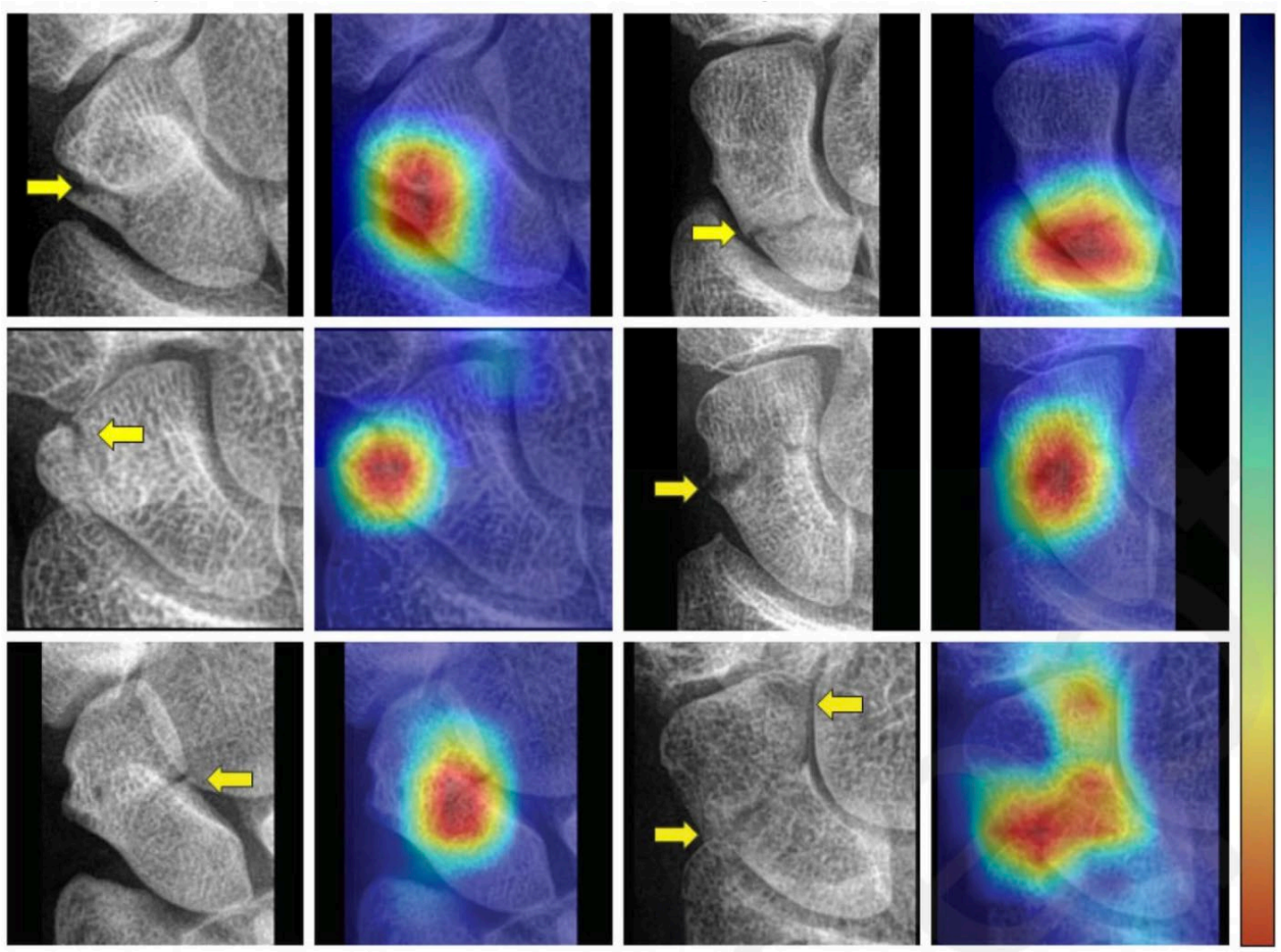
Development and Validation of a Convolutional Neural Network for Automated Detection of Scaphoid Fractures on Conventional Radiographs

Nils Hendrix, Ernst Scholten, Bastiaan Vernhout, Stefan Bruijnen, Bas Maresch, Mathijn de Jong, Suzanne Diepstraten, Stijn Bollen, Steven Schalekamp, Maarten de Rooij, Alexander Scholtens, Ward Hendrix, Tijs Samson, Lee-Ling Sharon Ong, Eric Postma, ... Show all authors

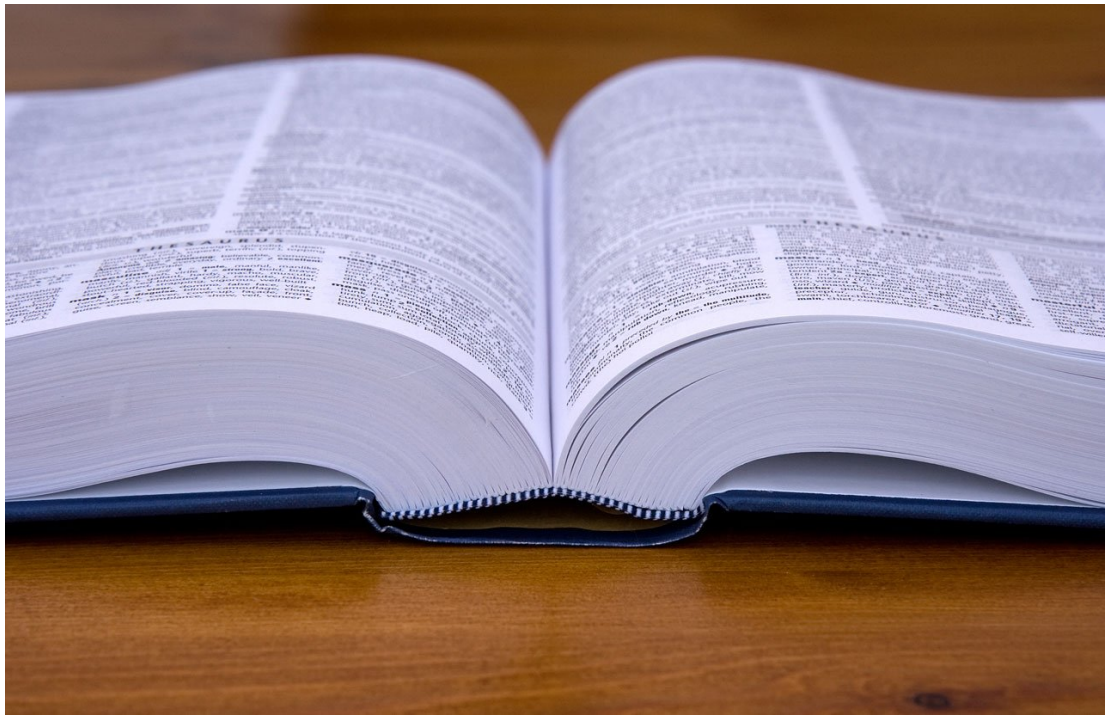
Author Affiliations

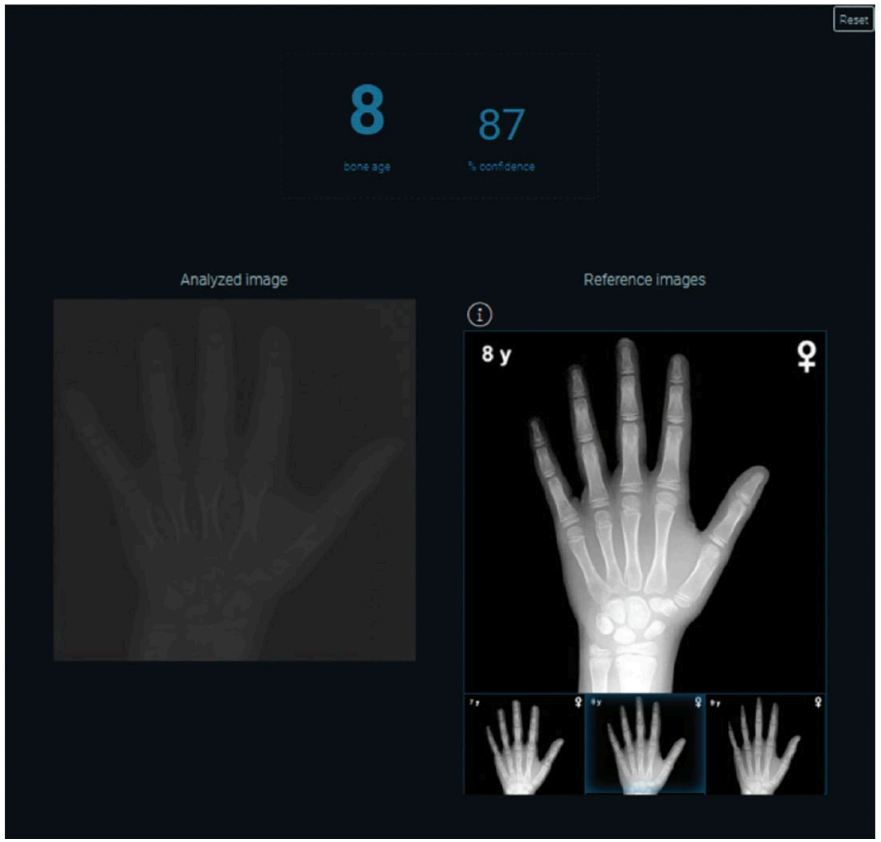
Published Online: Apr 28 2021 | https://doi.org/10.1148/ryai.2021200260

Blind spots: challenging diagnoses and common missed findings



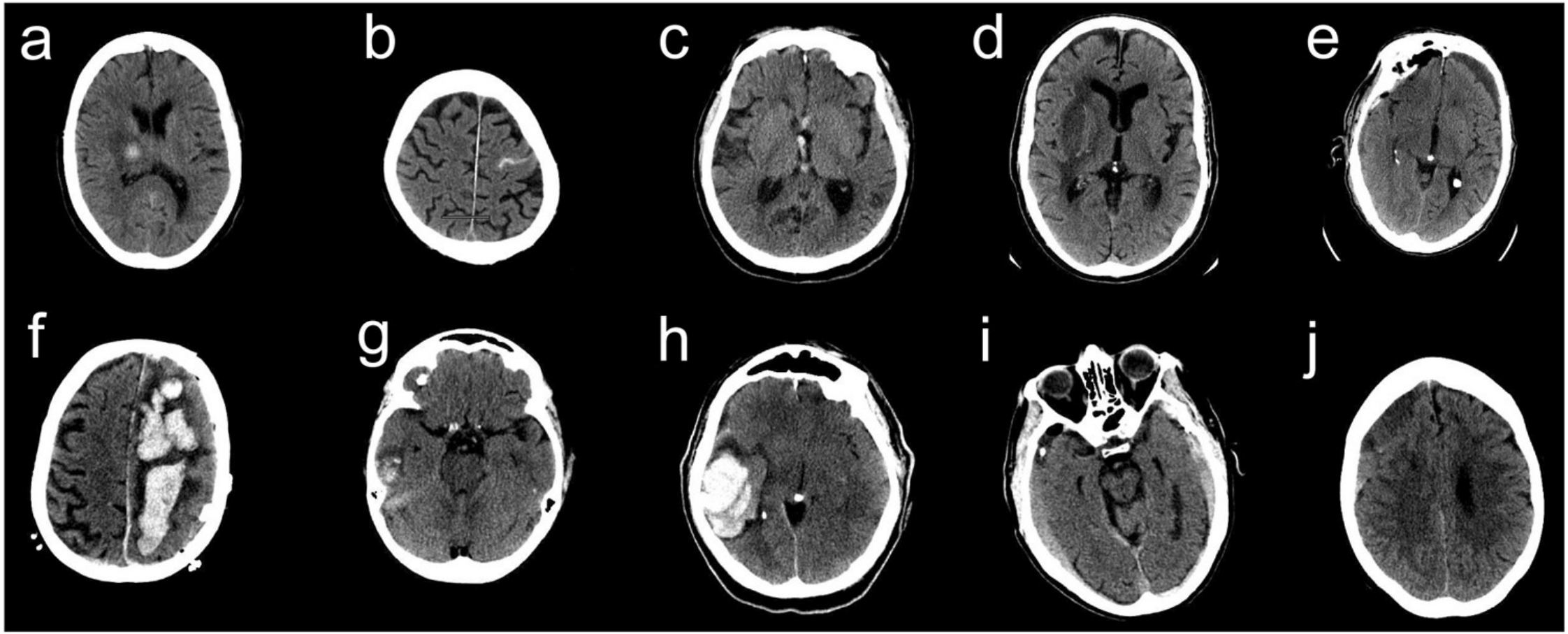
Automated bone age determination – enhancing accuracy, saving time, and reducing administrative burden





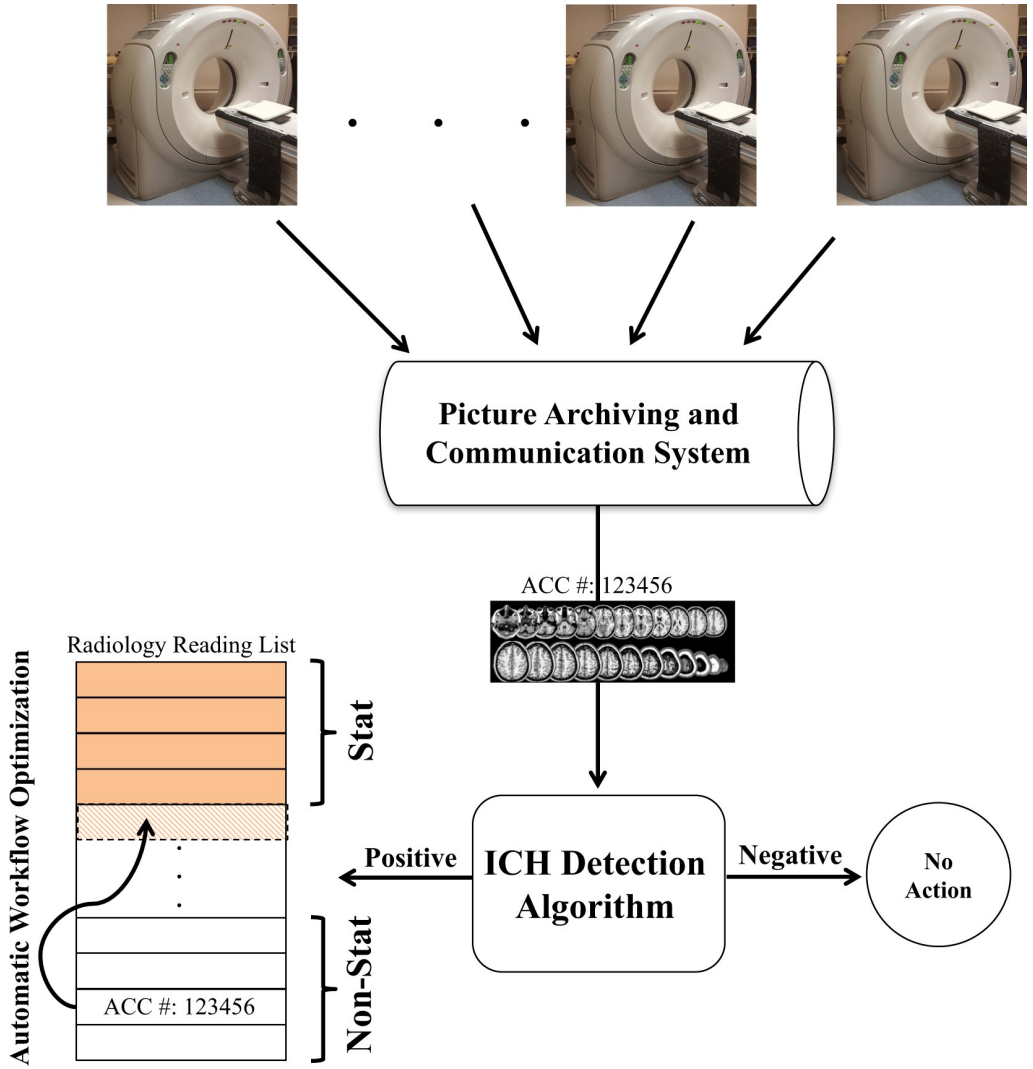
Opportunities exist to automate and help replace more manual workflows, such as use of book-based references.

Positive for intracranial hemorrhage on each case



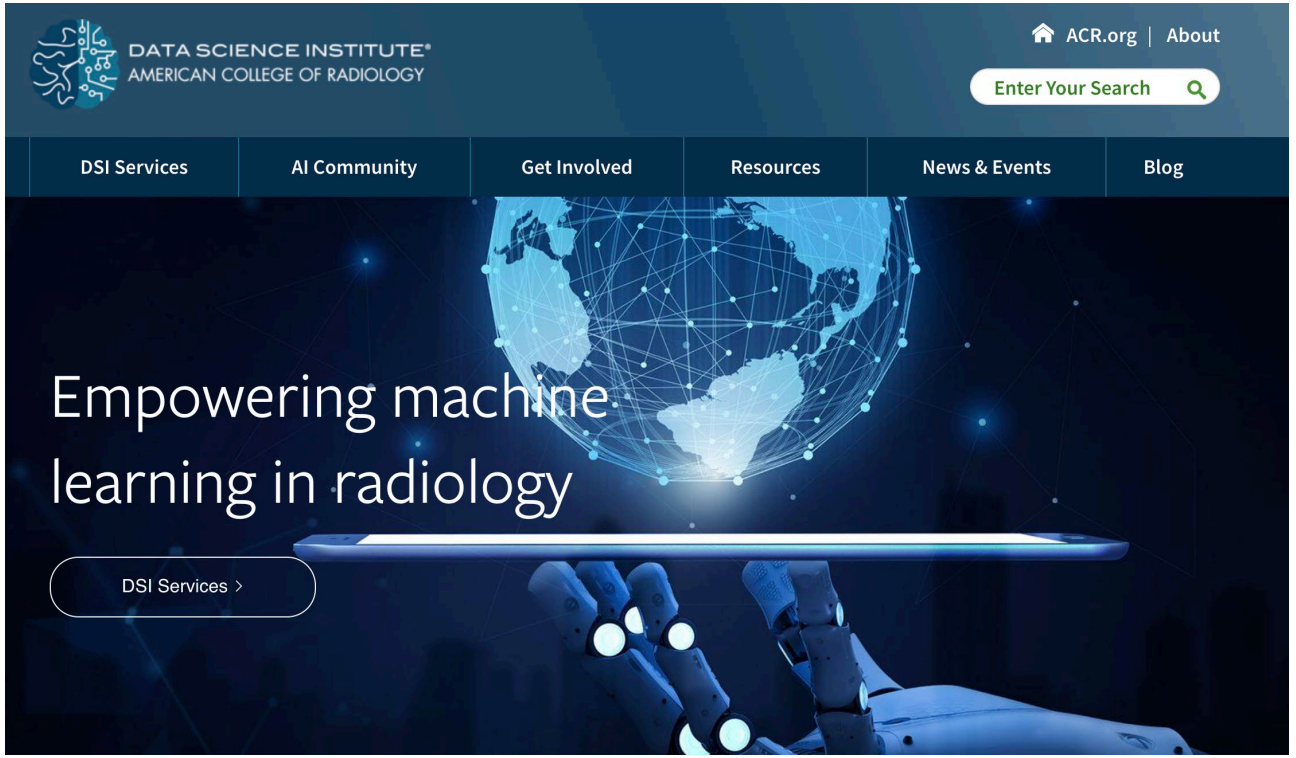
Workflow optimization and triage

- Key cases identified for radiologists to interpret as priority from the queue.
- Clinical triage via machine learning can improve outcomes and reduce any delay in diagnosis.



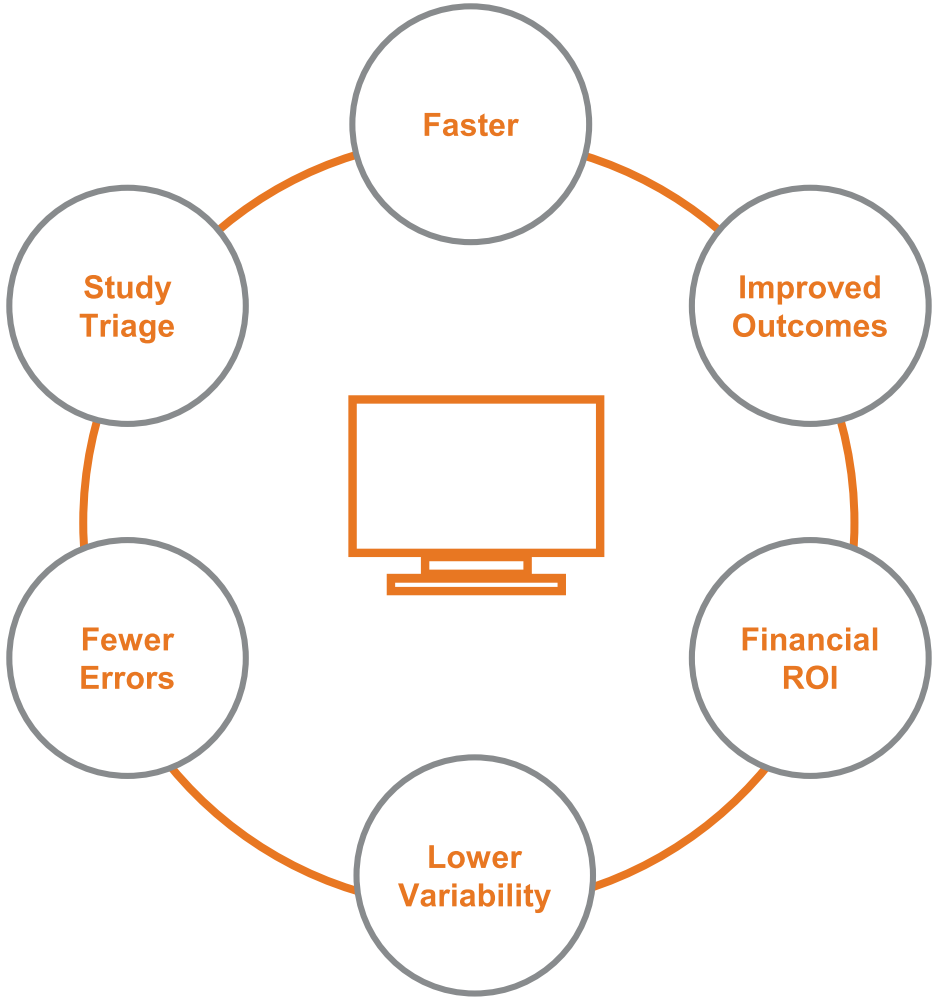
What is the ACR Data Science Institute?

Organization collaborating with radiology professionals, industry leaders, government agencies, patients, and other stakeholders to facilitate the development and implementation of artificial intelligence (AI) applications that will help radiology professionals provide improved medical care.



Key benefits of AI in enterprise imaging

Multiple benefits for enterprises with diagnostic imaging workflows ranging from improved clinical outcomes to productivity



Summary

- Machine learning has the potential to improve different steps of the radiology workflow including order scheduling and patient screening, clinical decision support systems, detection and interpretation of findings, postprocessing and dose estimation, and radiology reporting.
- Collection of high-quality ground truth data, development of generalizable and diagnostically accurate techniques, and workflow integration are key challenges for the creation and adoption of machine learning models in radiology practice.
- For the foreseeable future, widespread application of machine learning algorithms in diagnostic radiology is not expected to reduce the need for radiologists. Instead, these techniques are expected to improve radiology workflow, increase radiologist productivity, and enhance patient care and satisfaction.