

<<November 14th, 2018>>

Fostering a Strong Ecosystem for AI in Medical Imaging

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Disclosures [Blank]



AI presents a once-in-a-generation opportunity to dramatically improve patient care and lower the costs of high quality healthcare.



Something on the order of the huge forward leap in diagnosis from X-ray to PETMRI.





Not because AI is going to create a genius robot that is a far superior replacement to the radiologist.

But, to quote Stanford AI researcher
Sebastian Thurn:

*“[The way] machines made the
human muscle 1000 times stronger,
AI is going to make the human brain
1000 times smarter”*



Misalignment of financial incentives



Inertia



Fear of change



Decentralized healthcare



Hype that can't live up to reality

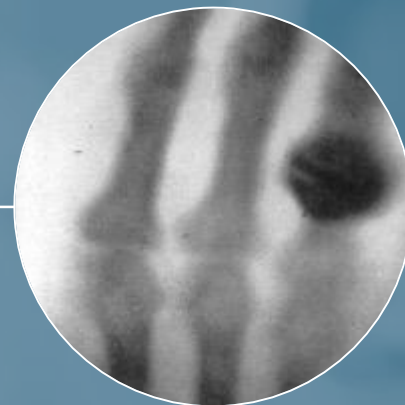


Complex AI and medical informatics



The path doesn't look like an expedition party climbing Mt. Everest.





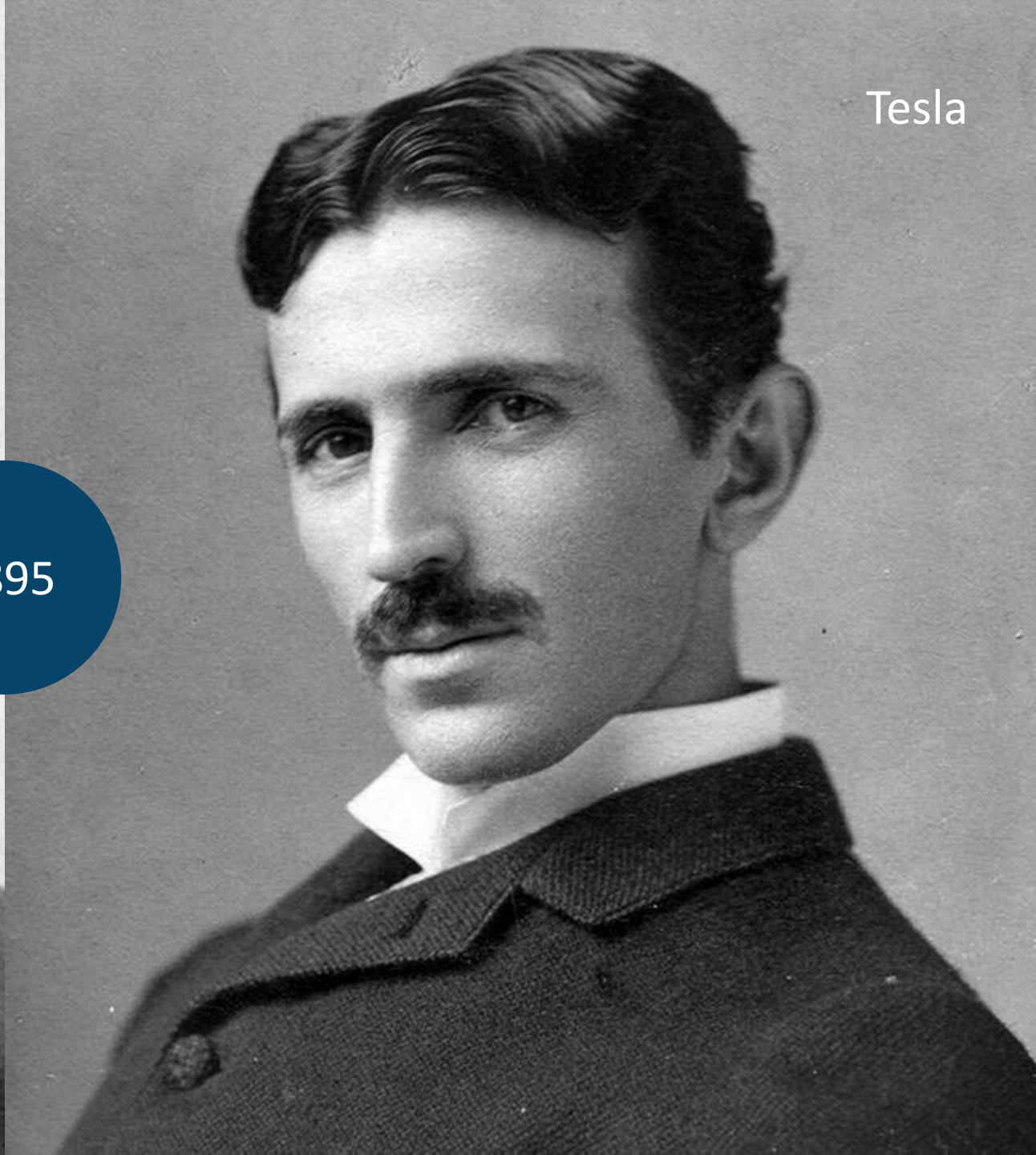
X-Ray as a Case Study in Rapid Adoption

Innovation in healthcare can be lightning fast but often fraught with errors and missed opportunities that cost lives.

Röntgen



Tesla

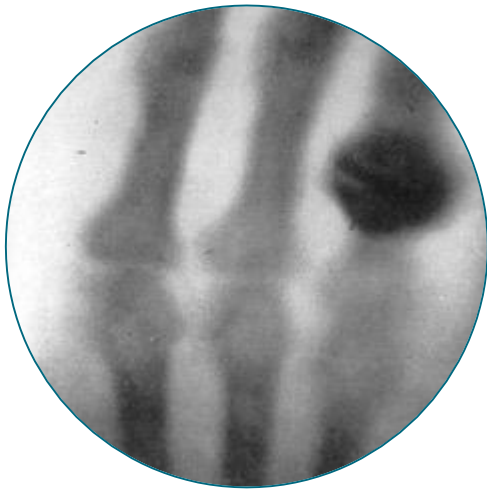


1895

First x-ray image in Ohio 4 months later

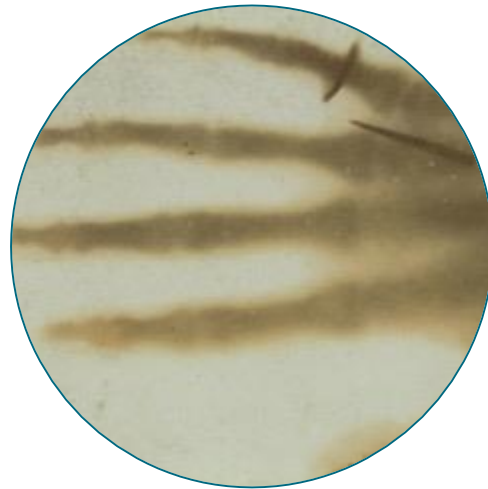
Wilhelm Roentgen discovers X-rays Wuerzburg Germany - 1895

1895



Hand of Roentgen's wife.
*Note wedding ring

1896



4 months later Kenyon College,
Ohio judge- nail in hand.



1st description of Physicists
and physician partnership
in imaging research?

Thanks to Dr. Jeffrey Duerk



No innovation is without risk or
unintended consequences

VOL. 100, NO. 160.

Mme. Curie of Radium Fame, Dead

Co-Discoverer With Her Husband of Priceless Curative Agent, She Becomes Its Victim—Its Rays Induce Pernicious Anemia



RADIUM v. GREY HAIR

Who'd Dream she was 50?

50—and not a grey hair to be seen. Wonderful! Yet an absolute fact. Let 'CARADIUM' do for you what it has done for thousands of our clients in all parts of the world.

A circular illustration of a woman's head in profile, facing left. She has dark, wavy hair styled in a bun, with no grey hair visible.

A circular logo for the American College of Radiology's Appropriateness Criteria. The background is purple. In the center is a blue-tinted illustration of a human skeleton. The text 'ACR Appropriateness Criteria' is at the top, and '25th Anniversary' is in a large font with a yellow ribbon banner. At the bottom, it says 'AMERICAN COLLEGE OF RADIOLOGY'. To the right is a smaller circular logo for 'I Made the Pledge image gently' featuring a monarch butterfly and the website 'www.imagegently.org'.



Apple Ecosystem

Infrastructural Components



Third-party Applications and Services

Applications and Services

THE VERGE

TECH

SCIENCE

CULTURE

CARS

REVIEWS

LONGFORM

VIDEO

APPLE

BUSINESS

TECH

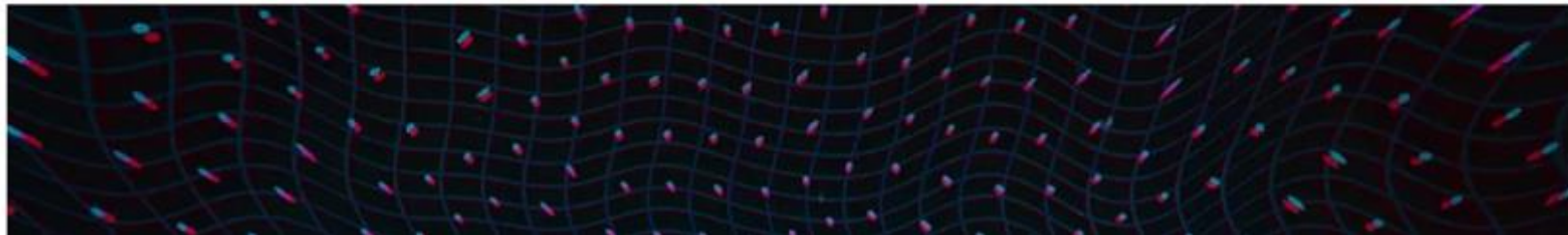
Apple is now a \$1 trillion company

'A billion dollars isn't cool. You know what's cool? A trillion dollars'

By [Chaim Gartenberg](#) | [@cgartenberg](#) | Aug 2, 2018, 11:53am EDT



SHARE





 Apple Ecosystem



Primary Beneficiary

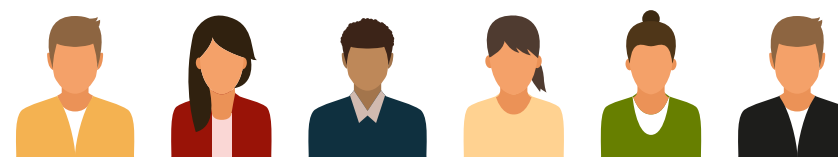
Apple's Shareholders

Other Beneficiaries

Apple's Users, Partners
and Employees



AI in Medical Imaging Ecosystem



Primary Beneficiary

Patients

Other Beneficiaries

Those who serve the patients
(Providers and Provider Organizations,
Vendors, Insurers, Regulators,
Associations/Societies)

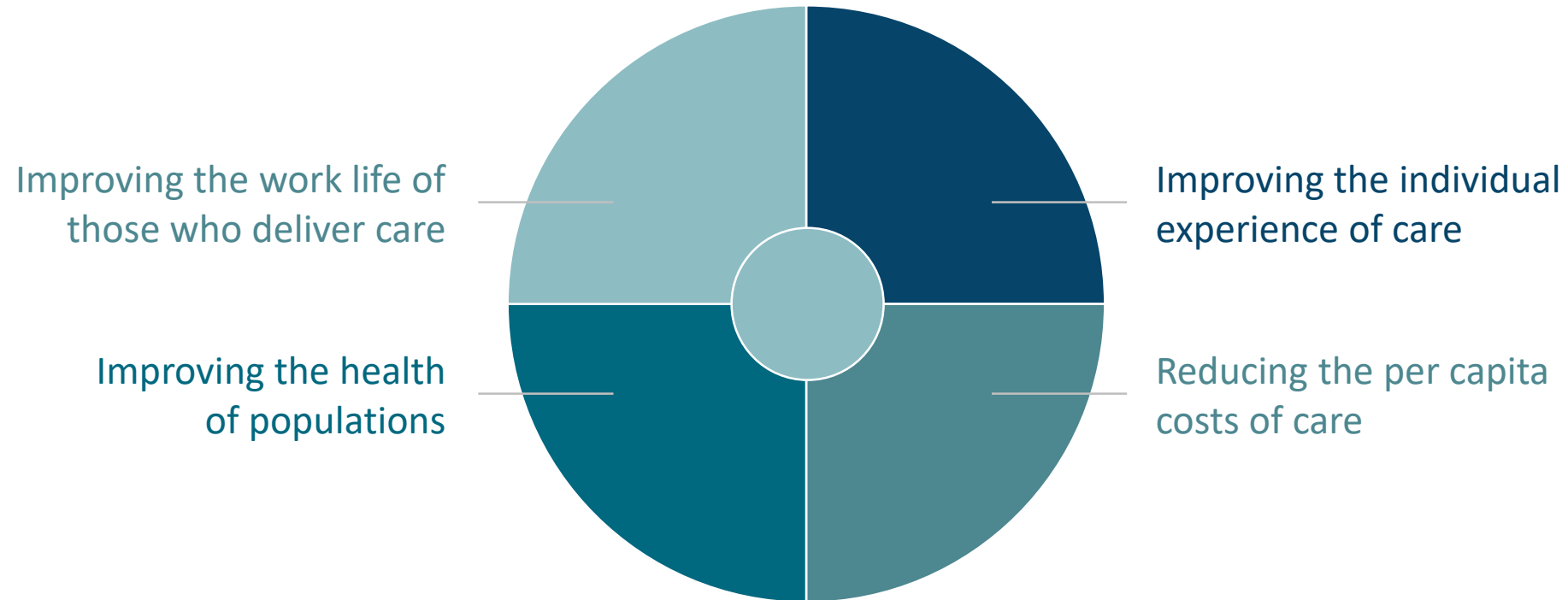


Making imaging safe, effective and accessible to those who need it.

The ACR's Core Purpose is to serve patients and society by empowering members to advance the practice, science, and professions of radiological care.



Doing *Better* With Less...

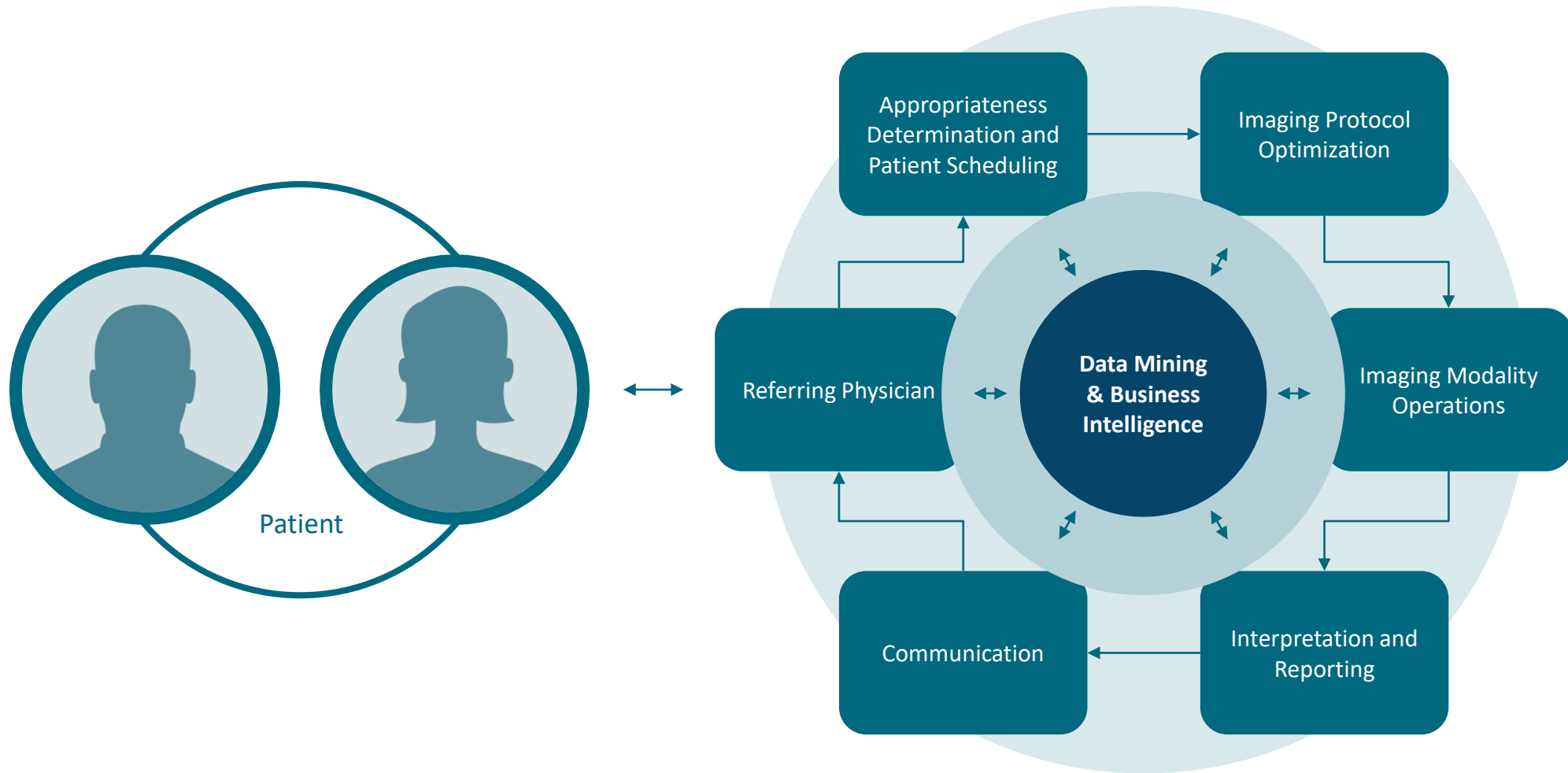


... Through Medical Imaging.

Improving care for 100+ years
by embracing new technologies
and approaches to medicine.

Since 1895, to name just a few
innovations we've adopted...

- X-Ray
- Contrast Agents
- Ultrasound
- Nuclear Medicine
- Computed Tomography (CT)
- Magnetic Resonance Imaging (MRI)
- Interventional Radiology (IR)
- Evidence-Based Clinical Guidelines
- Picture Archiving and Communications Systems (PACS)
- Computerized Voice Recognition and Transcription
- Electronic Health Records
- Value-Based Medicine
- *Artificial Intelligence & Data Science*



Hype?
Yes.



Real Substance
and Impact?
Yes.

[News](#) > [Medscape Medical News](#) > [Oncology News](#)

Big Data Bust: MD Anderson-Watson Project Dies

Top Cancer Center Spent \$62M

Nick Mulcahy

February 22, 2017

 [Read Comments](#)

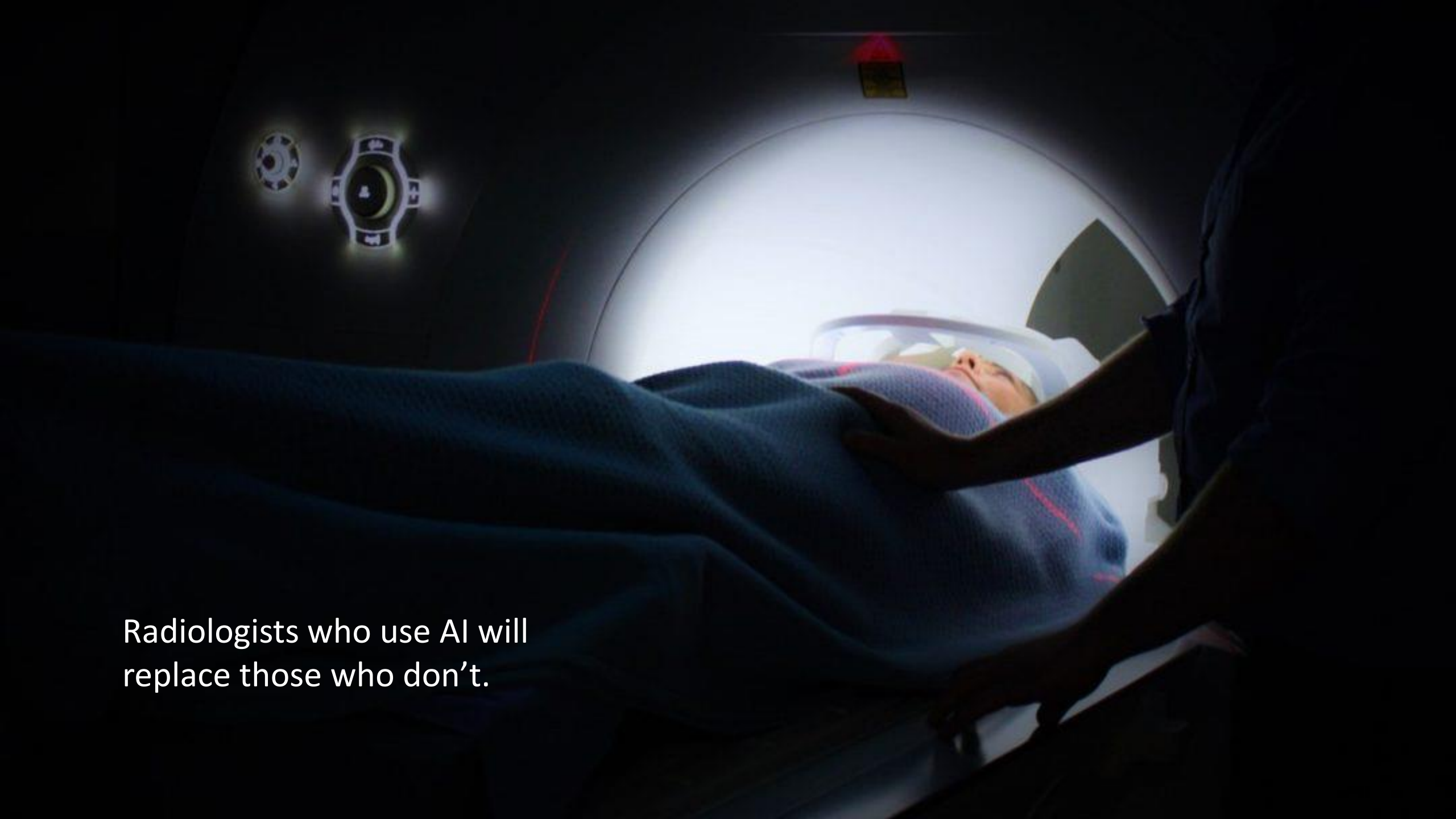
After 4 years of spiralling costs that now total at least \$62 million, a grandiose big-data project that was a collaboration between MD Anderson Cancer Center and IBM's Watson artificial intelligence system is over. The details emerged in a 48-page [audit report](#) from the University of Texas System that surfaced last week in news stories.

Sloan Kettering's Cozy Deal With Start-Up Ignites a New Uproar



At Memorial Sloan Kettering Cancer Center in Manhattan, doctors and staff objected to a for-profit venture that could be lucrative for a few leading researchers and board members.

Gabriella Angotti-Jones/The New York Times

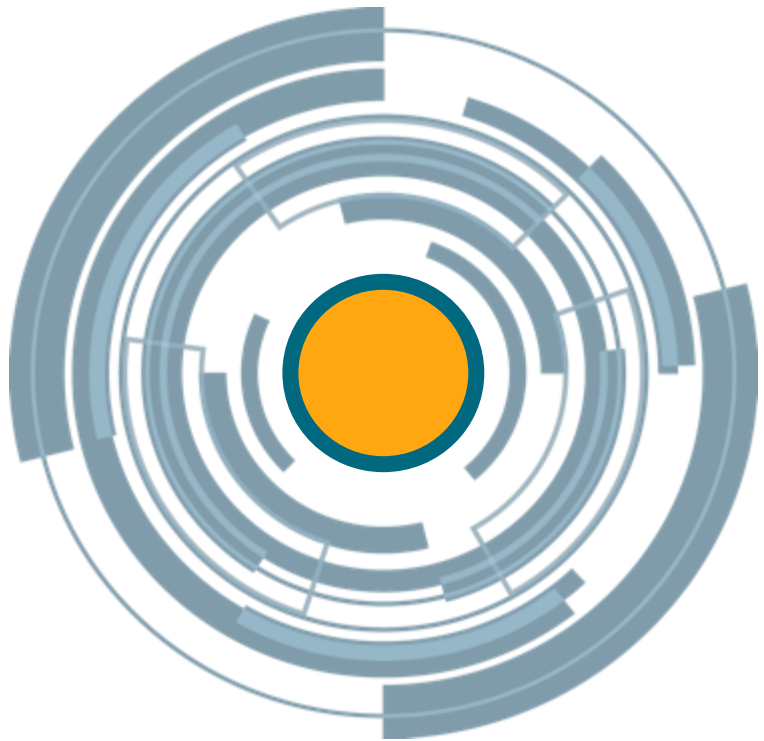


Radiologists who use AI will
replace those who don't.



Image interpretation

- Quantification of findings
- Quantified comparison between multiple studies
- Multiparametric analysis across multiple modalities
- Volumetric analysis
- Textural analysis
- Automation of Region Of Interest targeting and measuring



Patient care and safety

- Detection and prioritization of potentially critical results
- Radiation dose optimization
- Pre-test probability assessment of patient risk of positive findings and contrast reactions
- Cancer and mammography screening
- Automatic protocoling of studies from EMR data

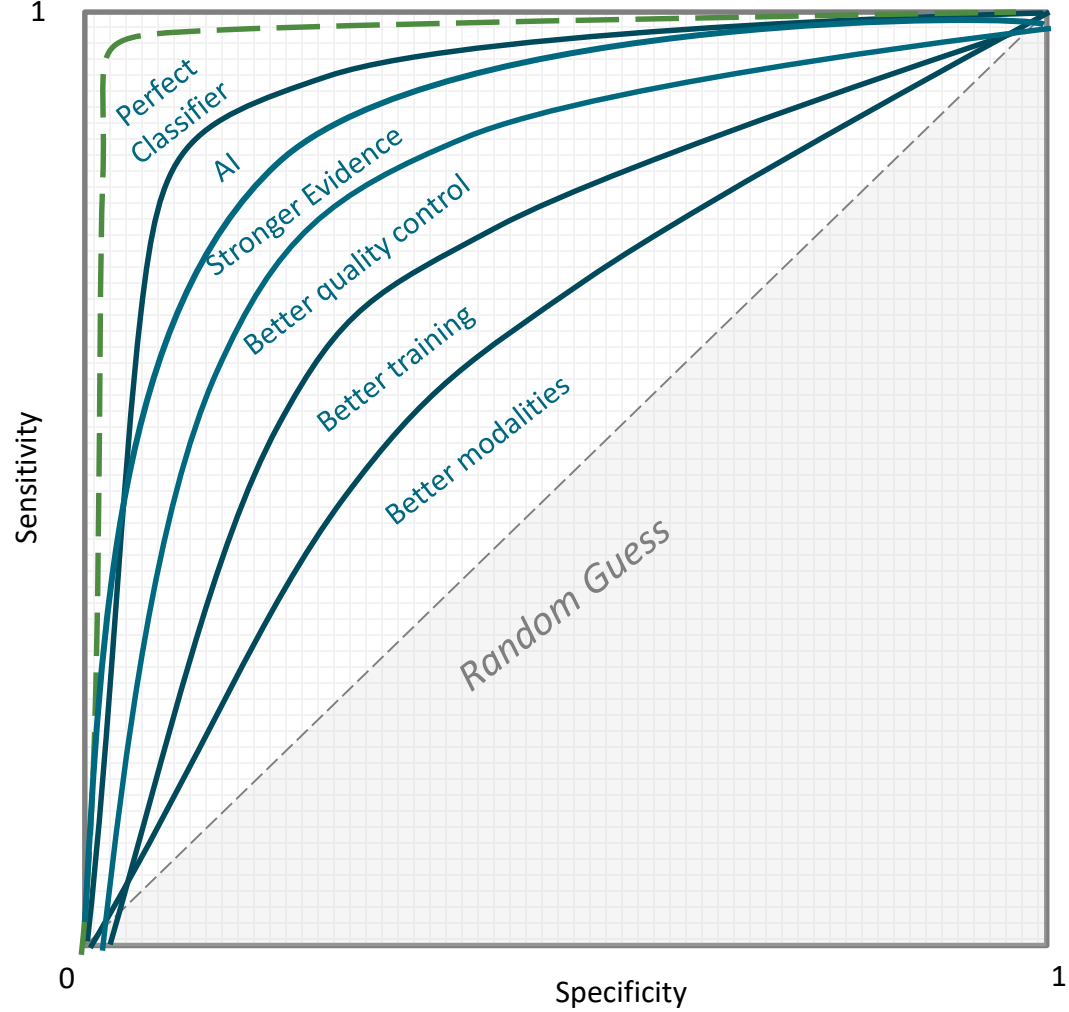


Practice optimization for productivity and quality

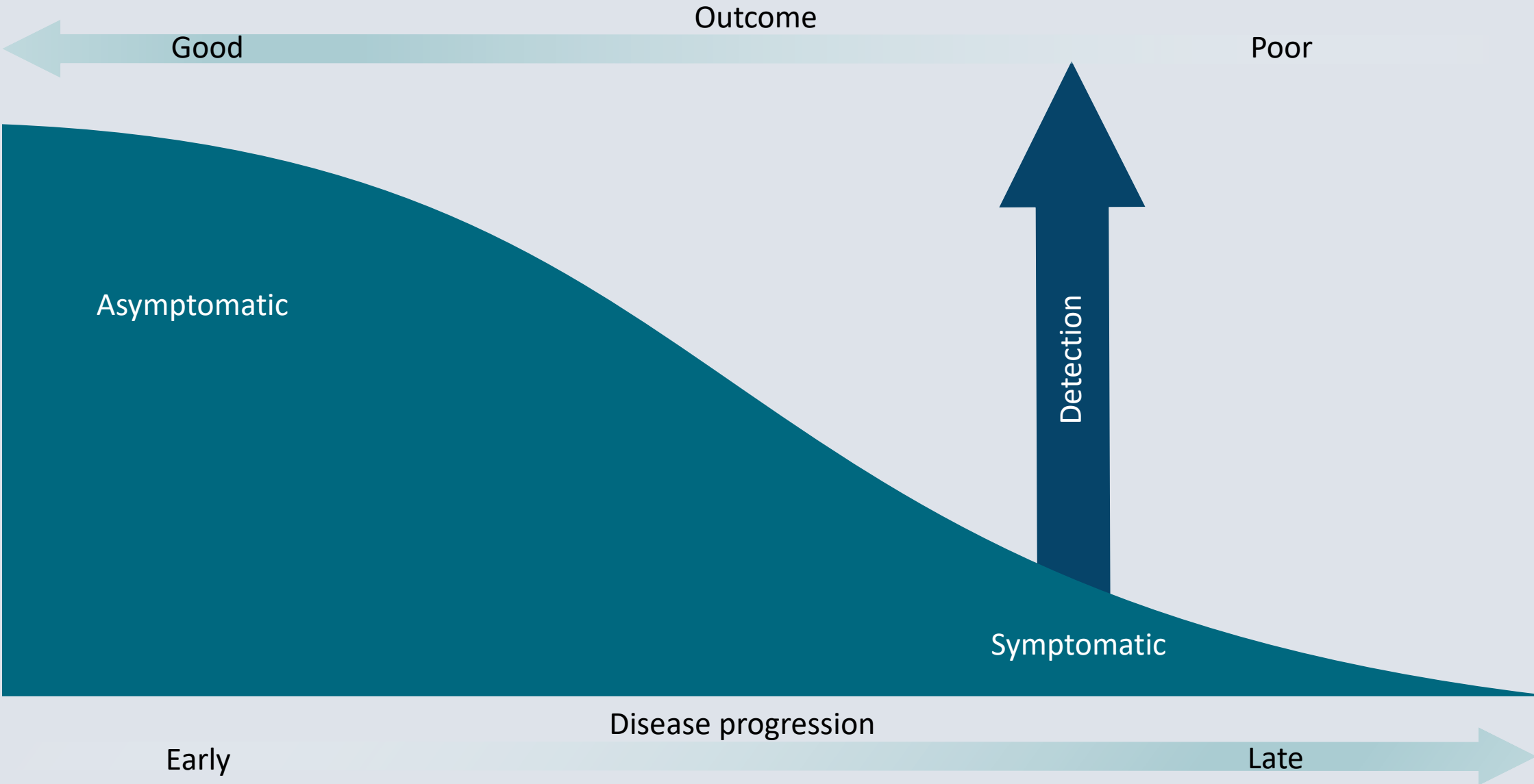
- Automated transcription of audio narration
- Automated population of structured reports
- Optimization for case assignment across teams
- Increased accuracy of coding
- Smarter PACS hanging protocols and synchronization protocols
- Communication and tracking of primary and incidental findings
- Decreased patient waiting times
- Quality improvement in scanning
- Prediction and prevention of missed patient appointments
- Preventing imaging machine outages

A Long Term
Goal for
Radiology

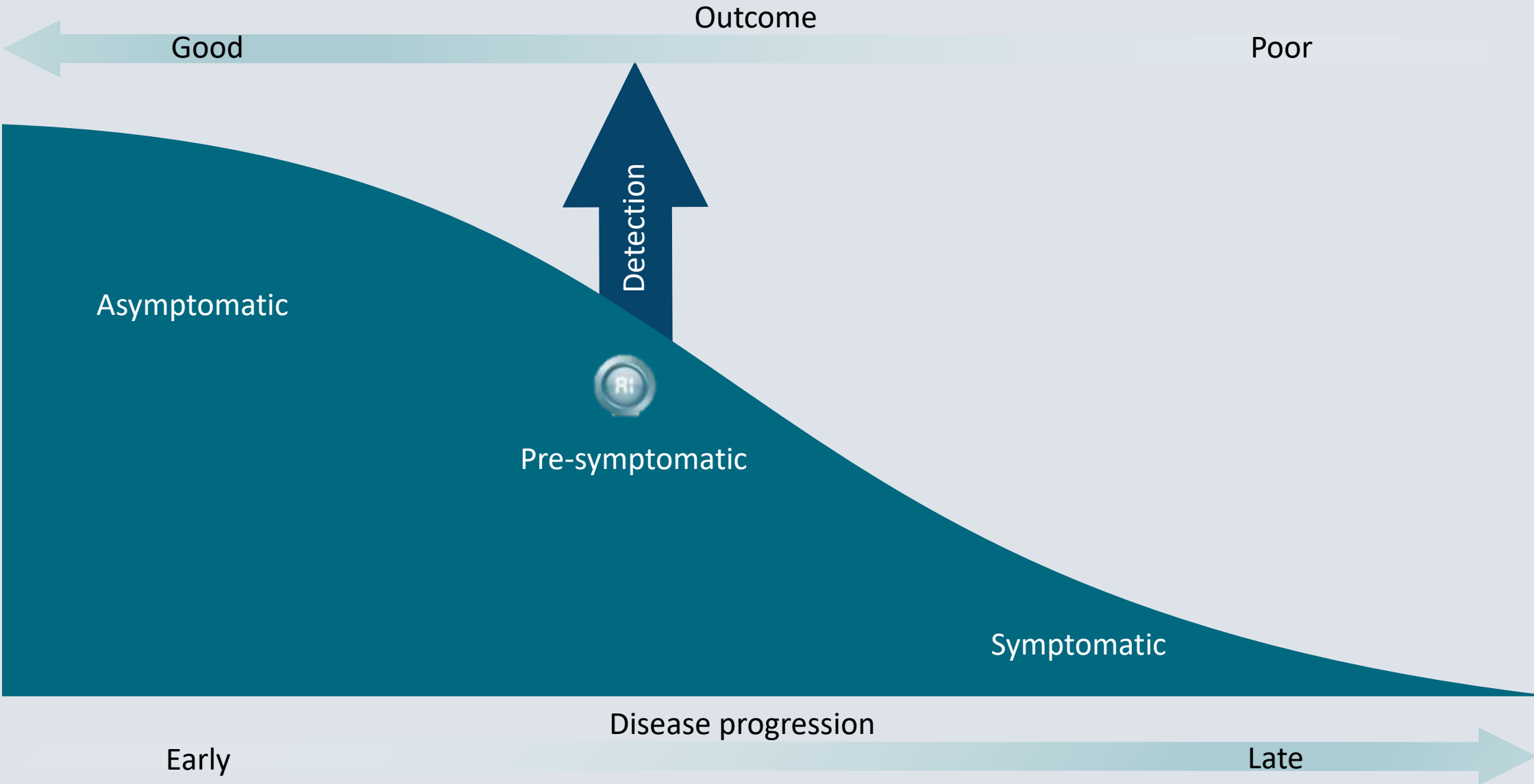
Receiver Operating Characteristic (ROC) Curves



Diagnostic Imaging, AI & Population Health

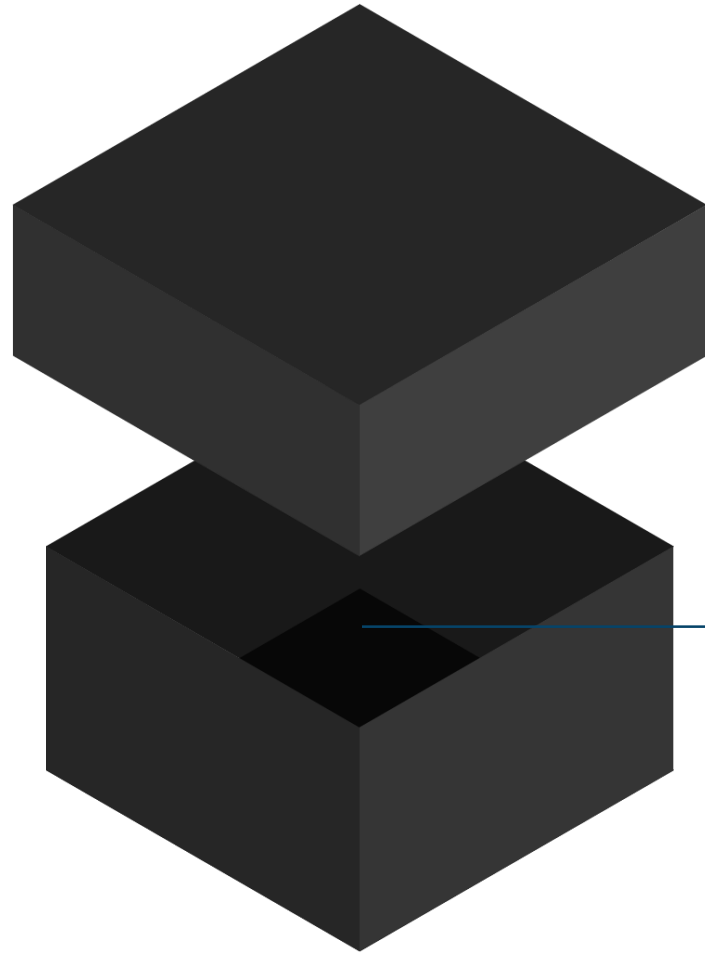


Diagnostic Imaging, AI & Population Health

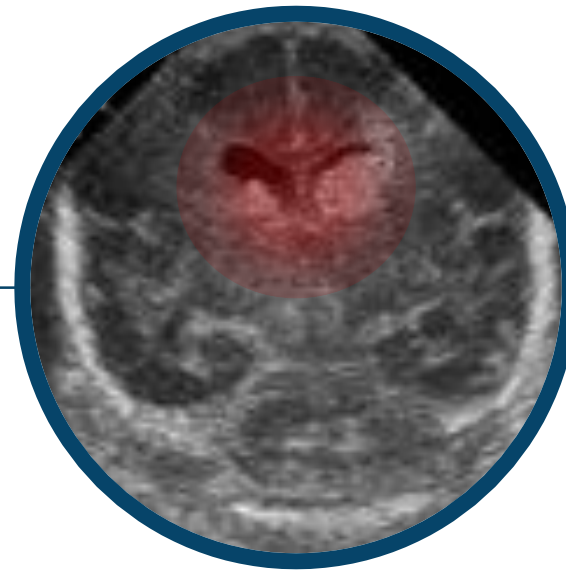




A challenge to radiologists embracing AI in practice is that we don't really understand how AI arrives at a particular conclusion.



Explicability



Neonatal
Intraventricular
Hemorrhage

Why is the algorithm effective?
What's inside the black box?

☰ **Money** | Everyday Money

A Second Self-Driving Tesla Crash Is Reported

 IEEE
SPECTRUM

Cover | Robotics | Artificial Intelligence

Can We Trust Robots?

Robots will soon have the power of life and death over human beings. Are they ready? Are we?

☰ **WIRED**

JASON TASHEA OPINION 04.17.17 07:00 AM

COURTS ARE USING AI TO SENTENCE CRIMINALS. THAT MUST STOP NOW

The New York Times

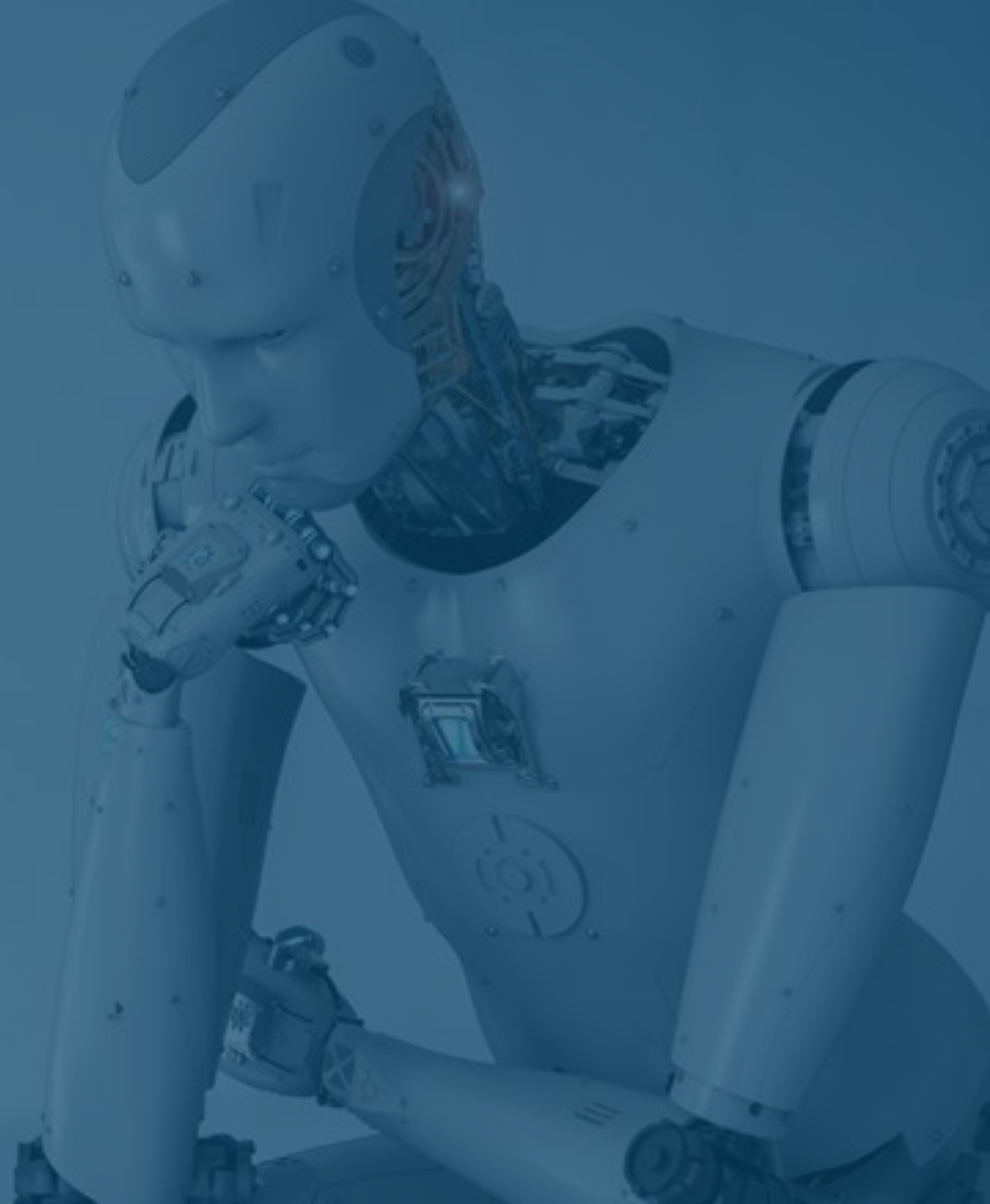
 **TheUpshot**

HIDDEN BIAS

When Algorithms Discriminate

Some rewards that computer has a hard time weighing:

- The patient's prior radiation dose exposure is unknown, which can this impact a decision of CT vs. MRI?
- Does the patient have to drive 3 hours to get to a more advanced imaging machine?
- Does the patient have claustrophobia that makes it hard to go in certain machines?
- The patient is losing her insurance at the end of the month, so a follow-up exam in the future may not be feasible.
- The patient suffers from multiple, co-morbid conditions so how sure can we be that any one condition is the cause of the finding?
- How much might we learn from an immediate follow-up study and what are the cost-benefit factors of how this might impact decisions about the course of treatment?



Using Representative/Diverse Training Data: Multiple Dimensions of Image Variation



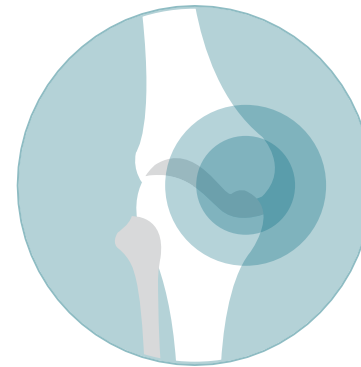
Anatomy

(e.g., body part)



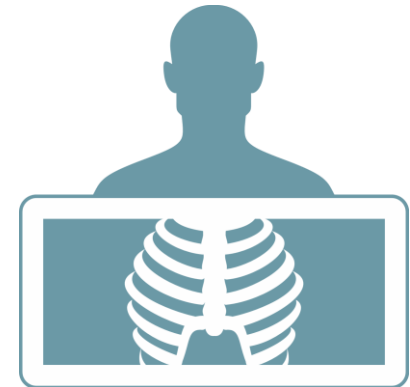
Patient demographics

(e.g., gender, age)



Pathology

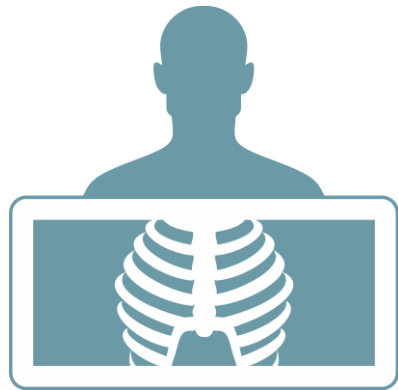
(e.g., degree of tear)



Modality

(e.g., X-Ray, MRI, CT, PET, Ultrasound)

Using Representative/Diverse Training Data: Multiple Dimensions of Image Variation



Modality

(e.g., X-Ray, MRI, CT, PET, Ultrasound)

Modality-specific variations

- MRI – For example:
 - Techniques (Pulse Sequences, Field of View)
 - Anatomic planes (axial, sagittal, coronal)
 - Equipment variation (Manufacturer, Product Version and Firmware/Software Version, Field Strengths, Signal-to-Noise Ratio)
- CT – For example:
 - Exposure parameters
 - Slice thickness
 - Number of detectors
 - Equipment variation

How can we make AI an indispensable tool for radiology professionals, referring physicians and patients?

ACR[®]

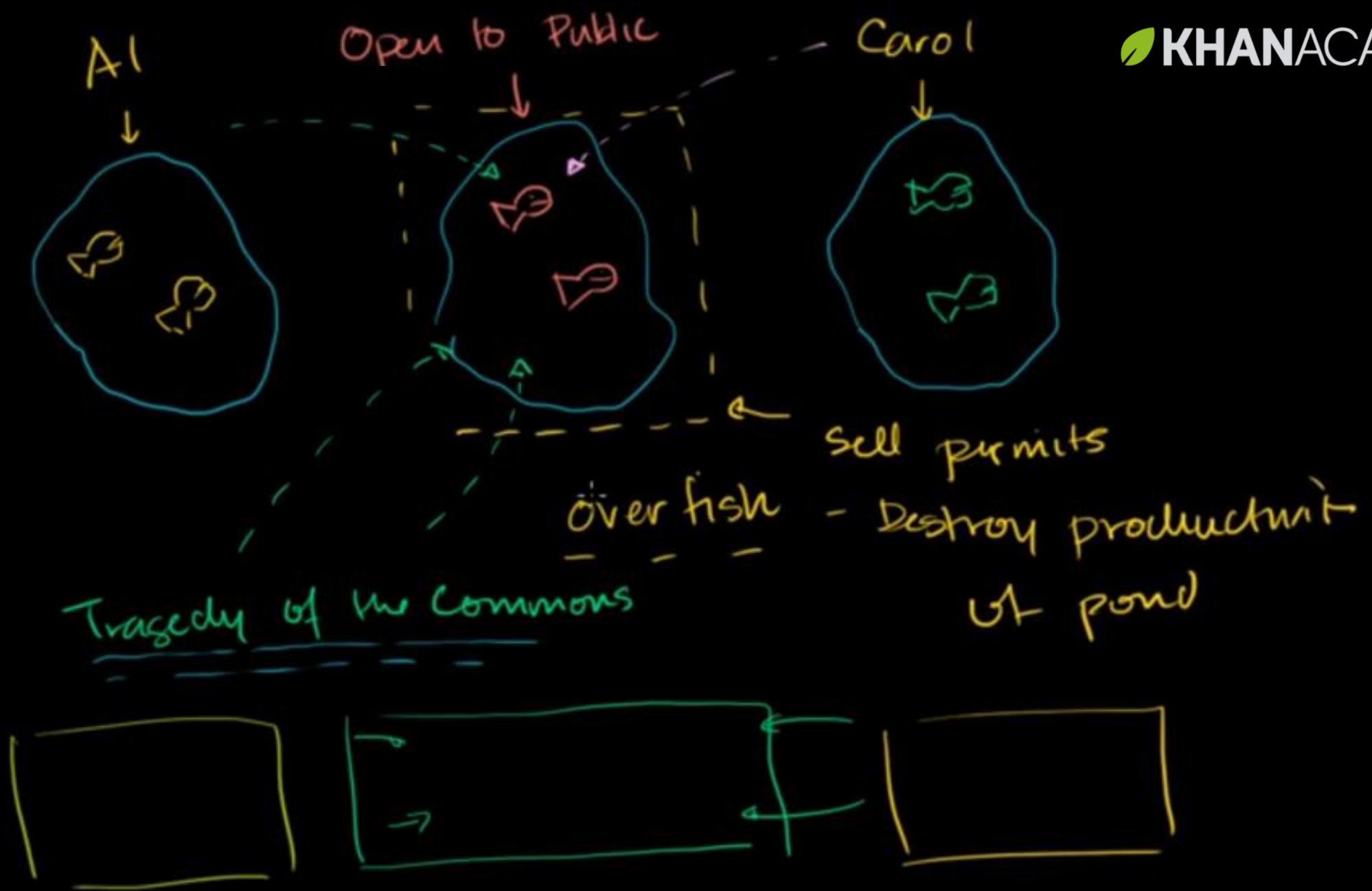


MICCAI



- Industry vendors
- Data scientists
- Physicians
- Informaticists
- Patient advocates
- Healthcare executives
- Regulators and policy makers
- Insurers
- Patients







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<http://www.acrdsi.org/>

Ensure the value of radiologists as AI evolves through the development of appropriate use cases and workflow integration

Establish industry relationships by providing credible use cases, help with FDA and other government agencies, and pathways for clinical integration



Protect patients through leadership roles in the regulatory process with government agencies and validation of algorithms

Educate radiologists, other physicians and all stakeholders about AI and the ACR's role in data science for the good of our patients

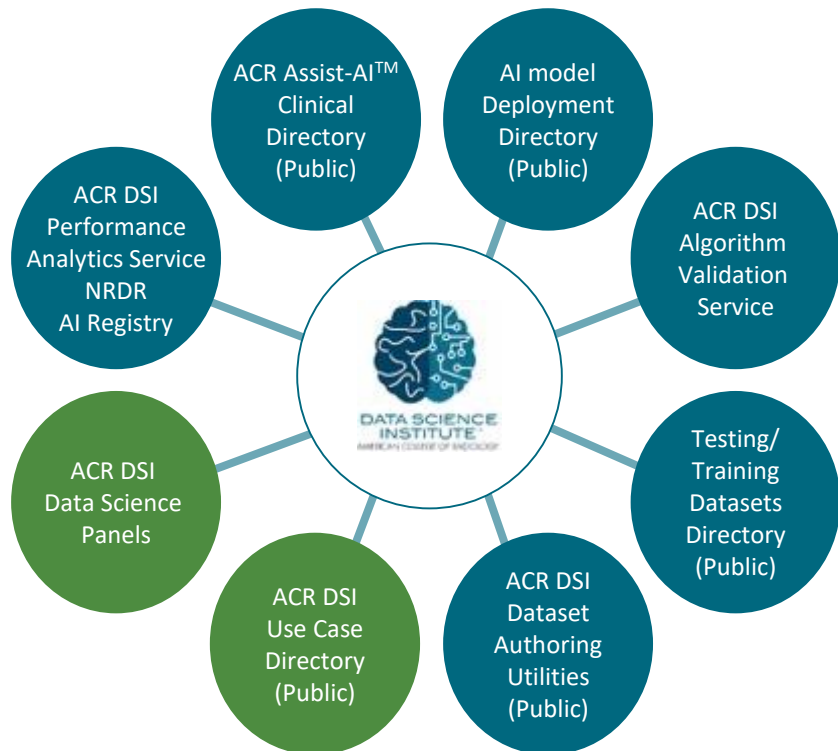


Protecting Patients From Unintended Consequences Of AI

- Algorithms useful, safe and effective
- Clinically validated
- Transparency in algorithm output
- Monitored in practice
- Free of unintended bias
- Medicare and insurance coverage issues



The Radiology AI Ecosystem Ideas To Clinical Practice



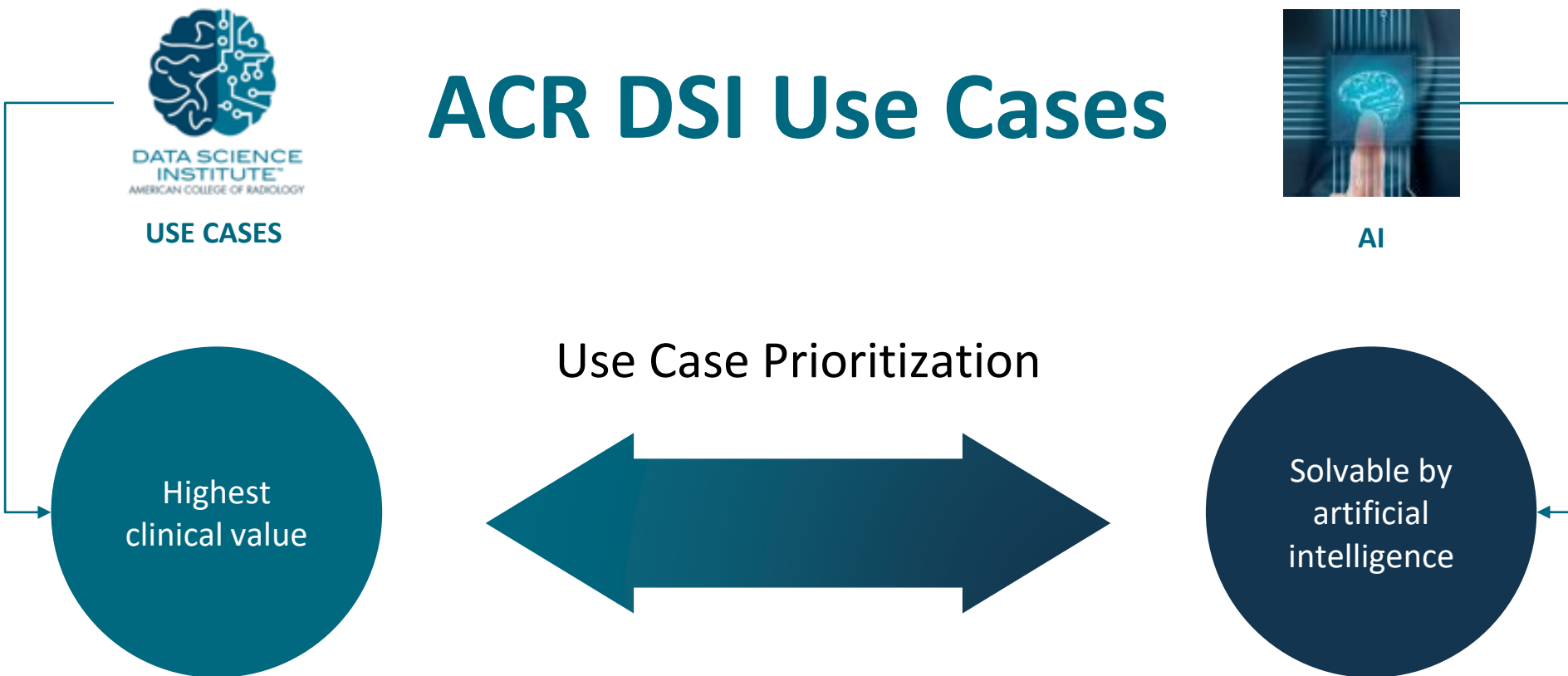
ACR® TOUCH-AI

Radiology's Value Proposition

- Trusted partnerships with industry and regulators
- Ensure patient safety
- Increase radiology professionals' value in healthcare

Use Case Development

- Use case authoring platform
- Human language to machine language





AI will persistently and pervasively enhance all aspects of radiology

- It's *not* about Human vs AI.
- It is about Human augmented by AI vs. Human working *without* AI