City of Hope

Multidisciplinary Approaches to Cancer Symposium

# Artificial Intelligence and the Future of Imaging

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Vice Chair of Education, Department of Radiology

Neuroradiology Section Chief

City of Hope

# Disclosures

- I do not have any relevant financial relationships.

*This presentation and/or comments will provide a balanced, non-promotional, and evidence-based approach to all diagnostic, therapeutic and/or research related content.*

# Cultural Linguistic Competency (CLC) & Implicit Bias (IB)

**STATE LAW:**

The California legislature has passed Assembly Bill (AB) 1195, which states that as of July 1, 2006, all Category 1 CME activities that relate to patient care must include a cultural diversity/linguistics component. It has also passed AB 241, which states that as of January 1, 2022, all continuing education courses for a physician and surgeon **must** contain curriculum that includes specified instruction in the understanding of implicit bias in medical treatment.

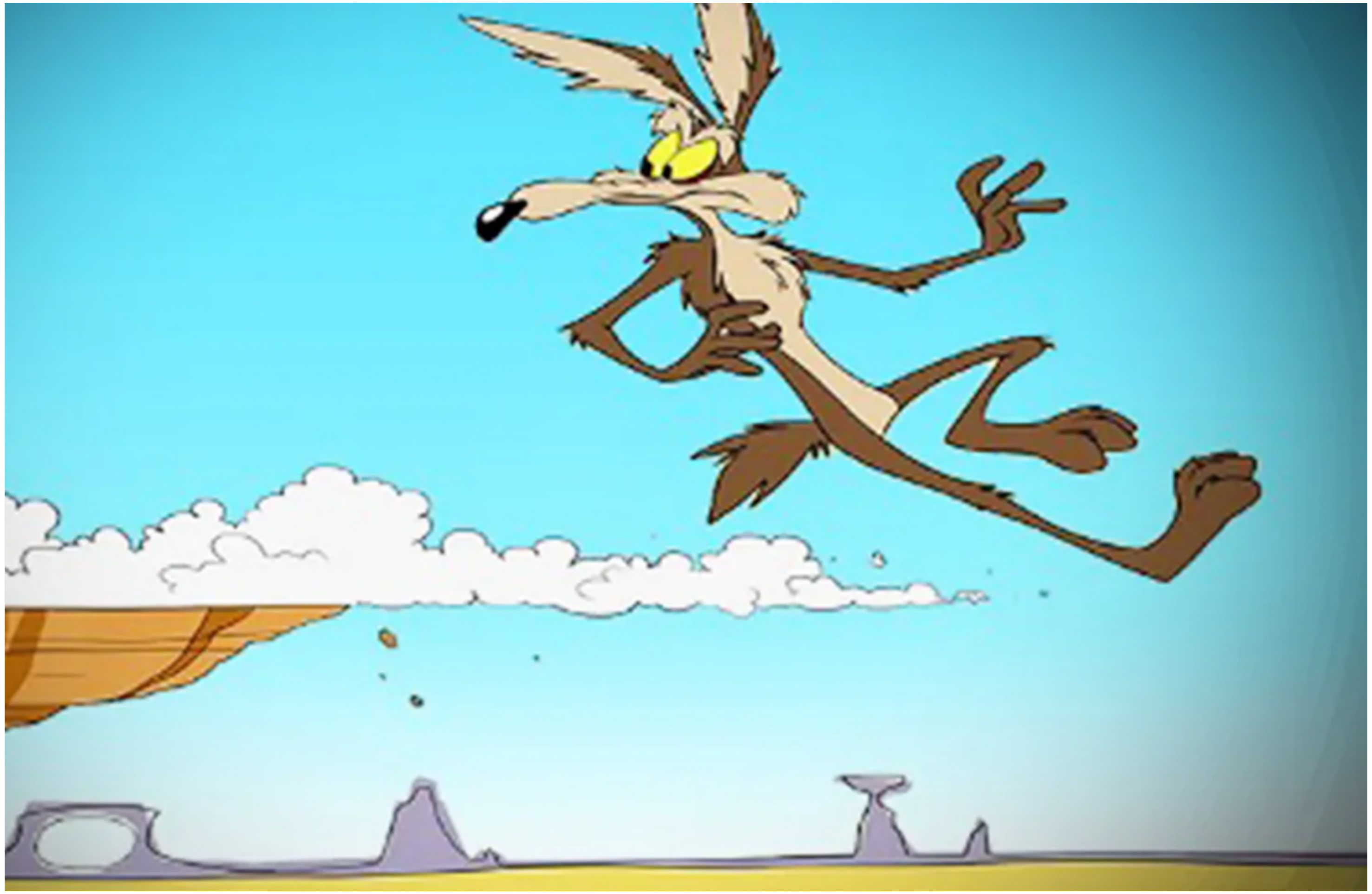
*The cultural and linguistic competency (CLC) and implicit bias (IB) definitions reiterate how patients' diverse backgrounds may impact their access to care.*

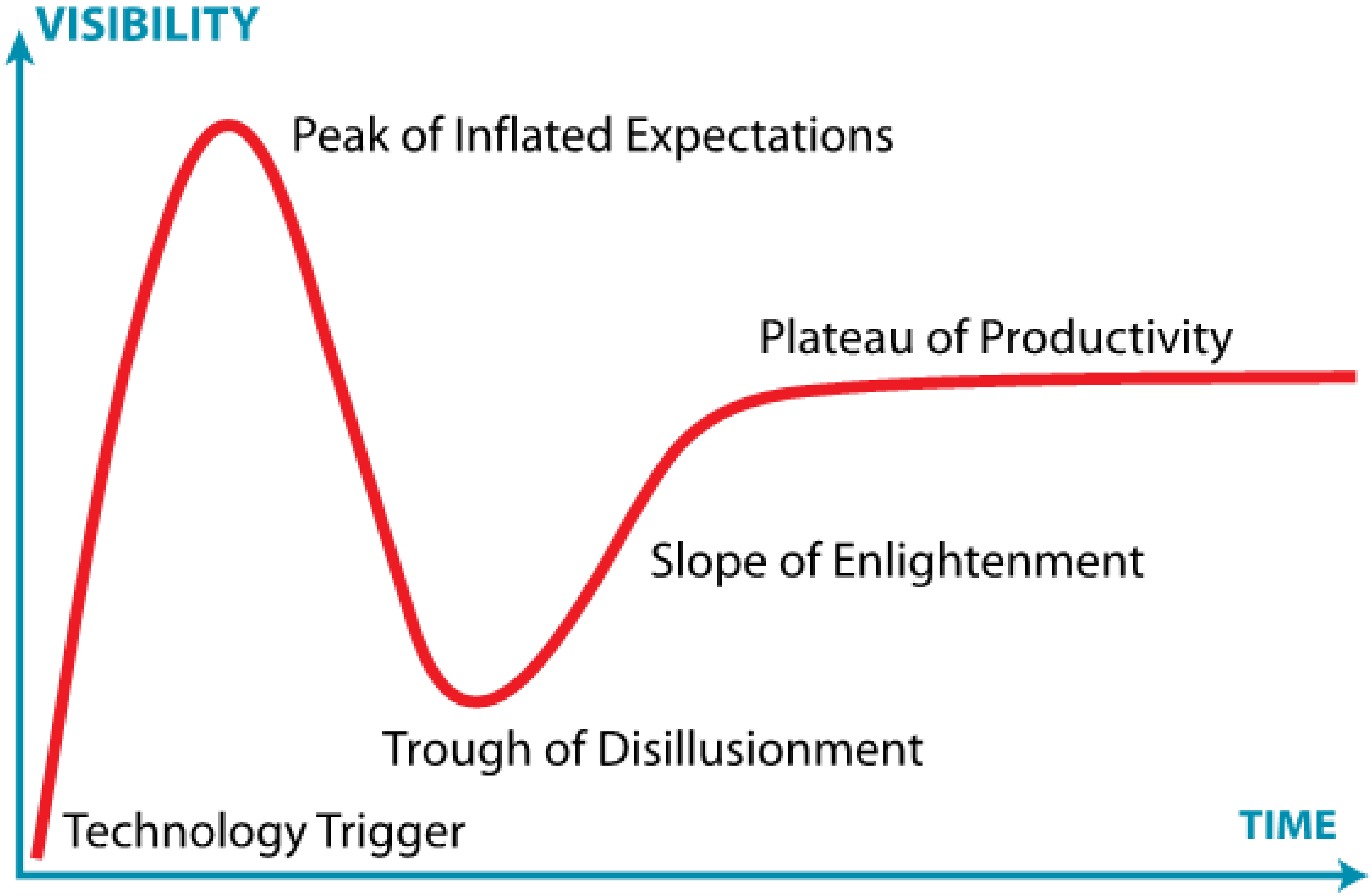
***EXEMPTION:***

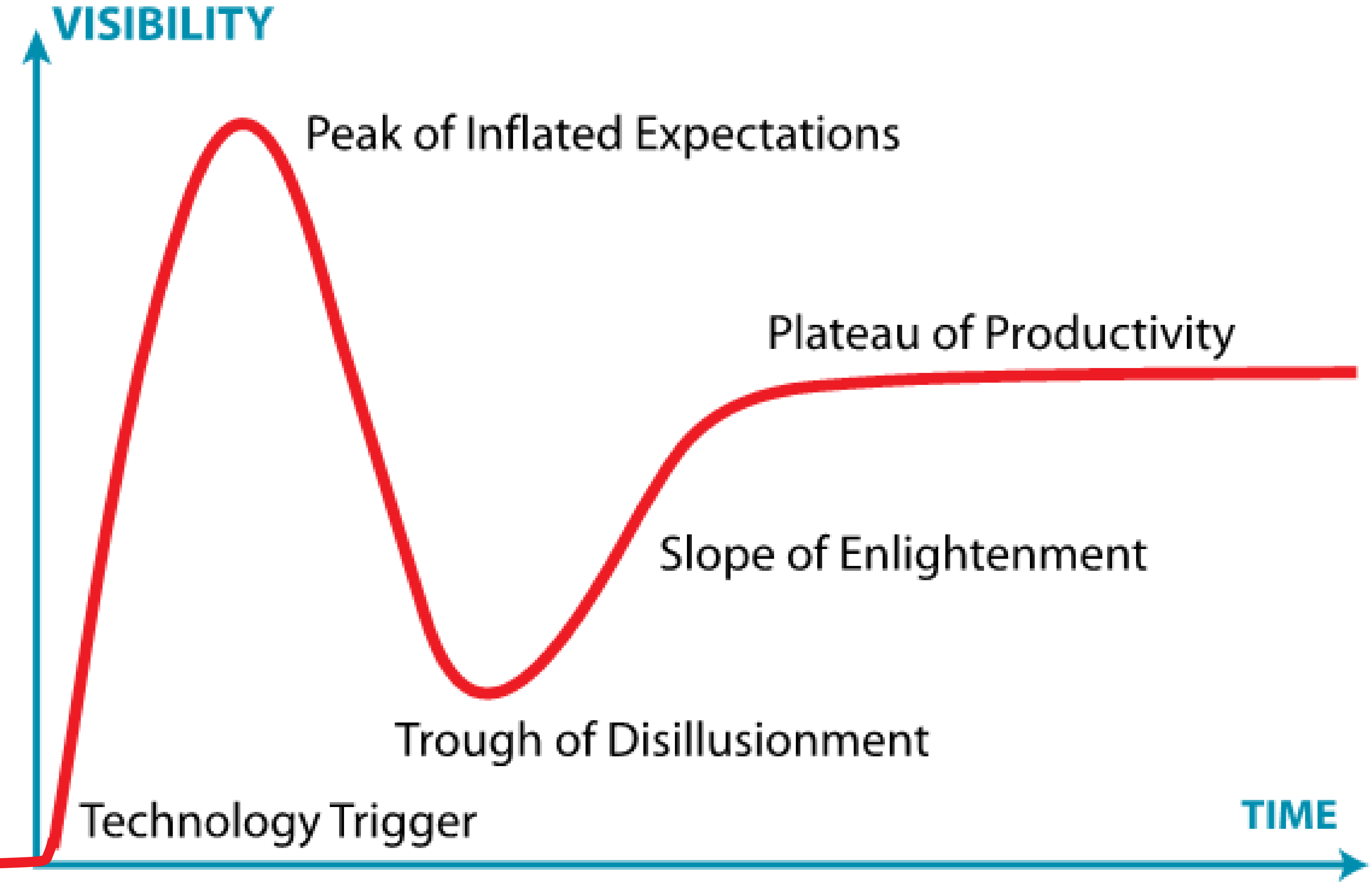
Business and Professions Code 2190.1 exempts activities which are dedicated solely to research or other issues that do not contain a direct patient care component.

***The following CLC & IB components will be addressed in this presentation:***

- *Discuss unknown confounders in data set used to train imaging algorithms in various patient groups and potential affects on model performance.*
- *Address implicit bias in adoption of AI models for imaging care of patients based on current concepts of standard of care from viewpoints of various stakeholders in chain of healthcare imaging decision making.*




VISIBILITY
Peak of Inflated Expectations
Plateau of Productivity
Slope of Enlightenment
Trough of Disillusionment
Technology Trigger
TIME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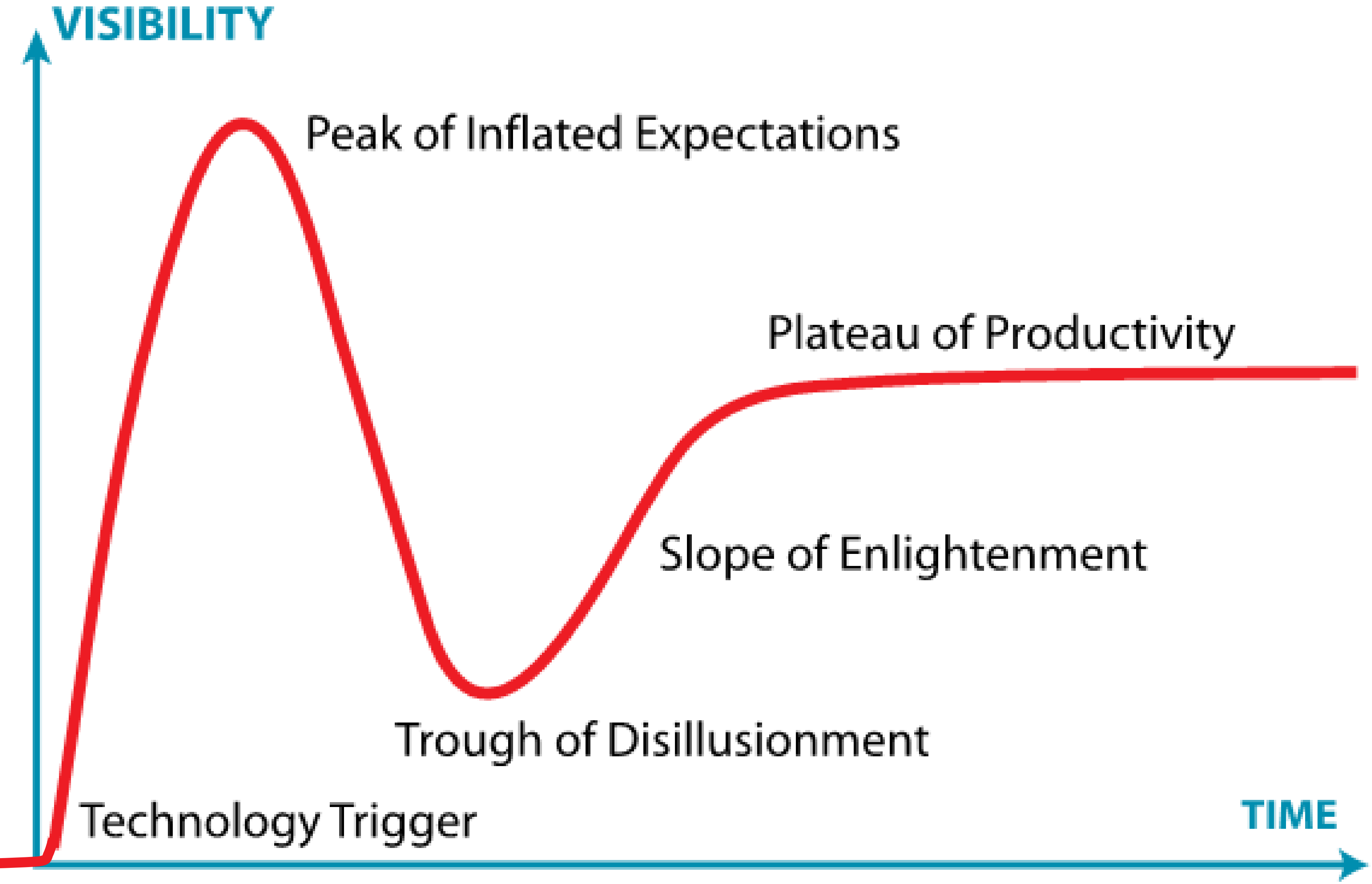
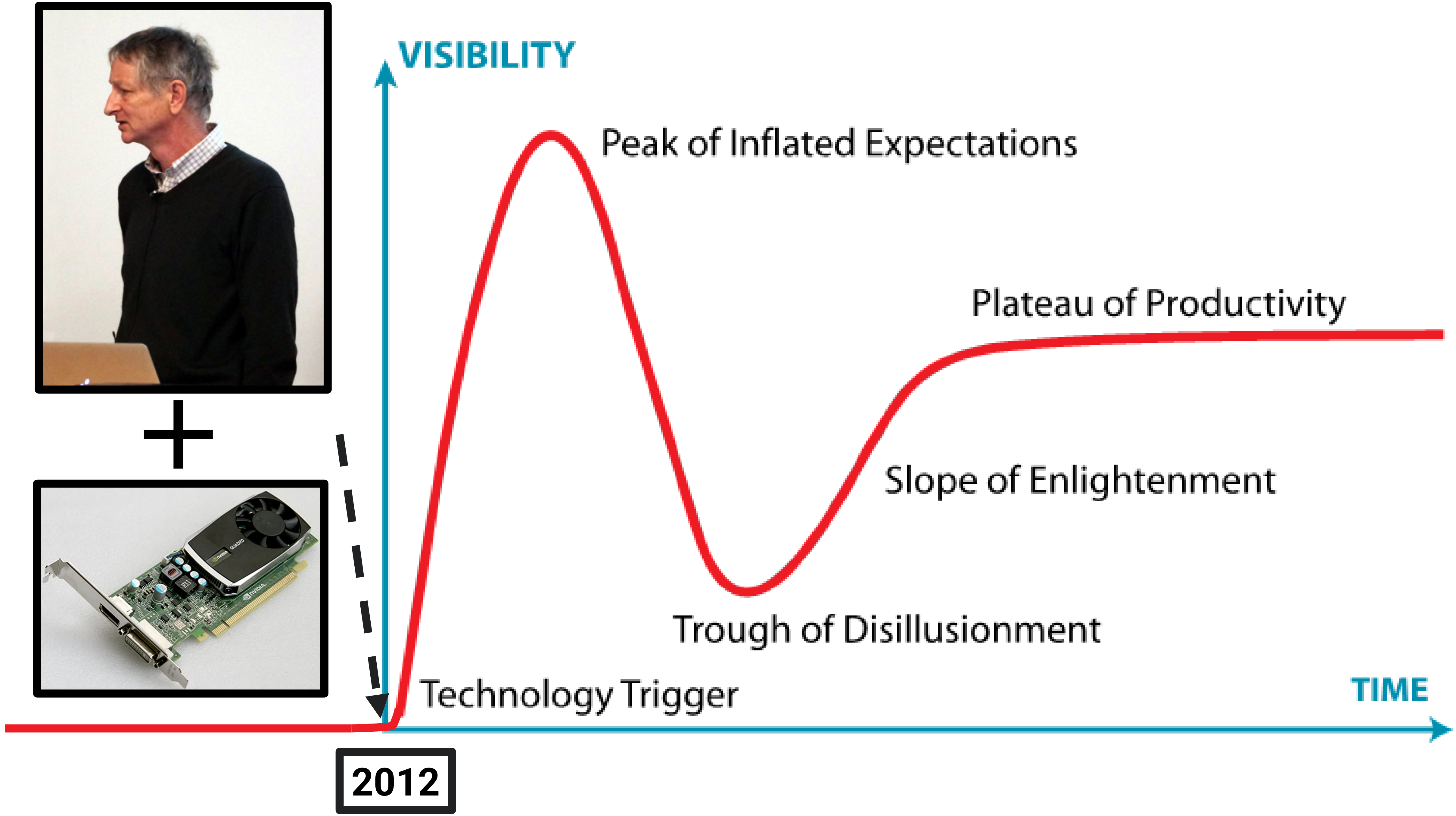



1987 → **University of Toronto – AI, Robotics, and Society**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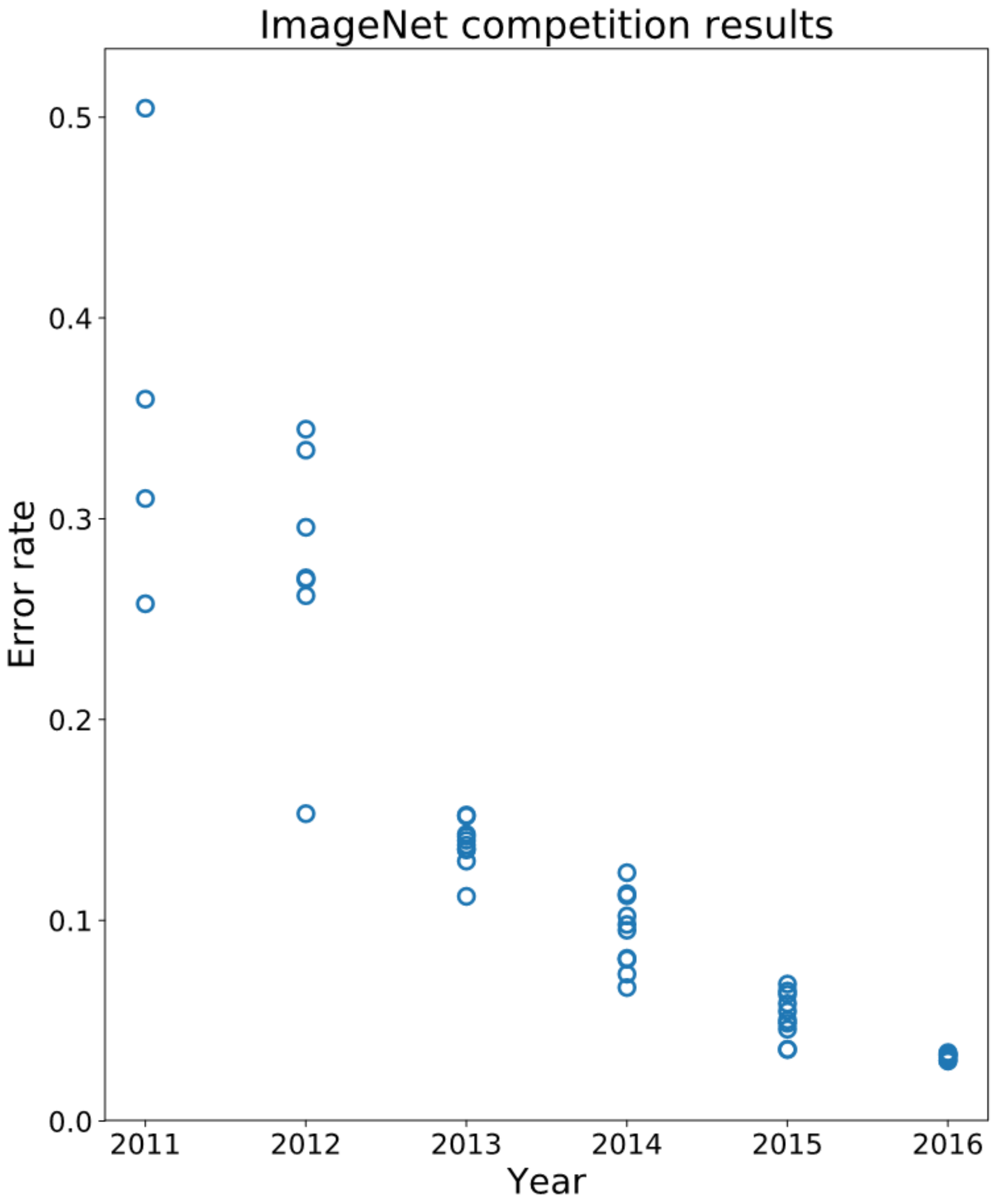
TIME
2012

ImageNet – 14m images, 22k categories



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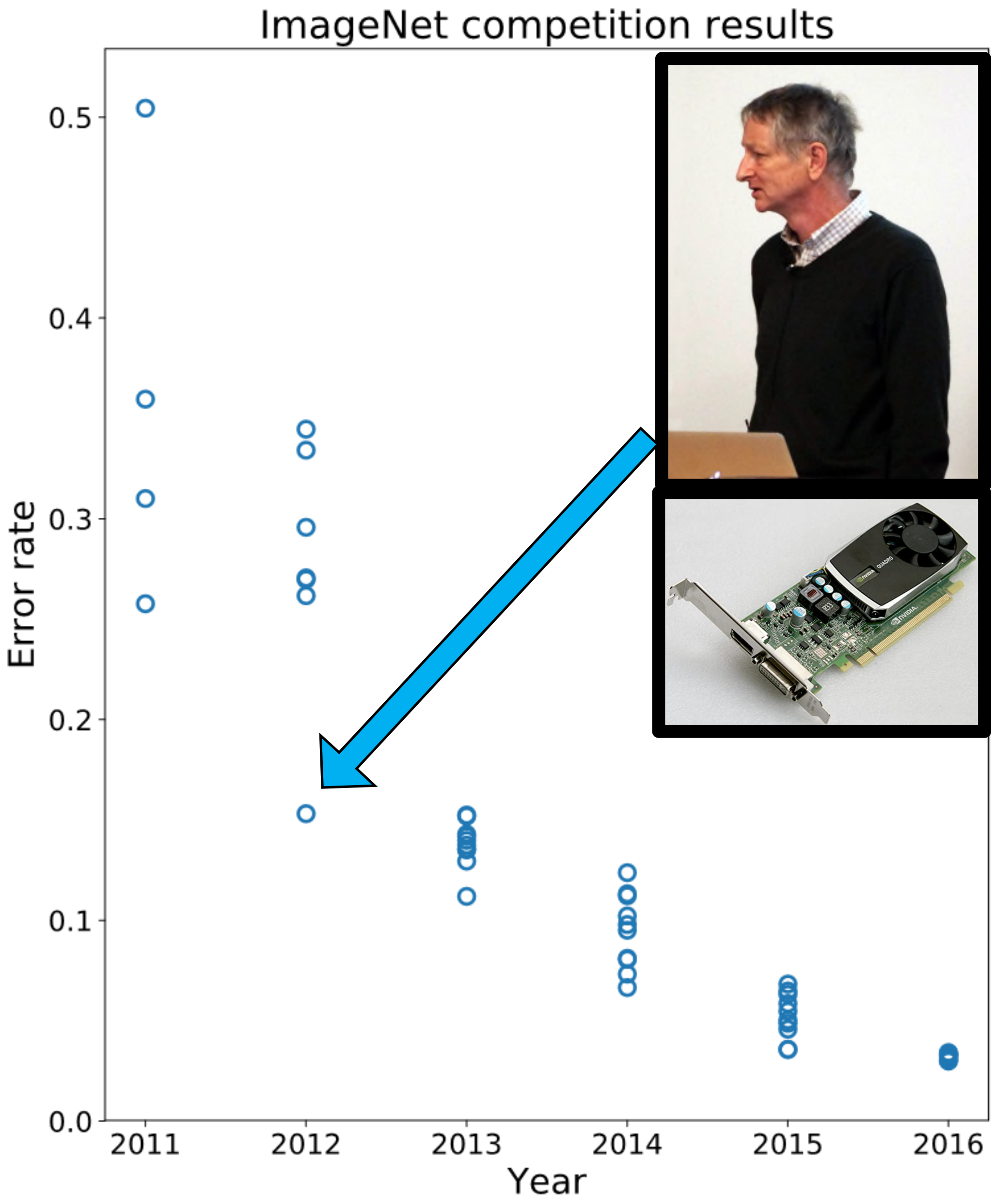

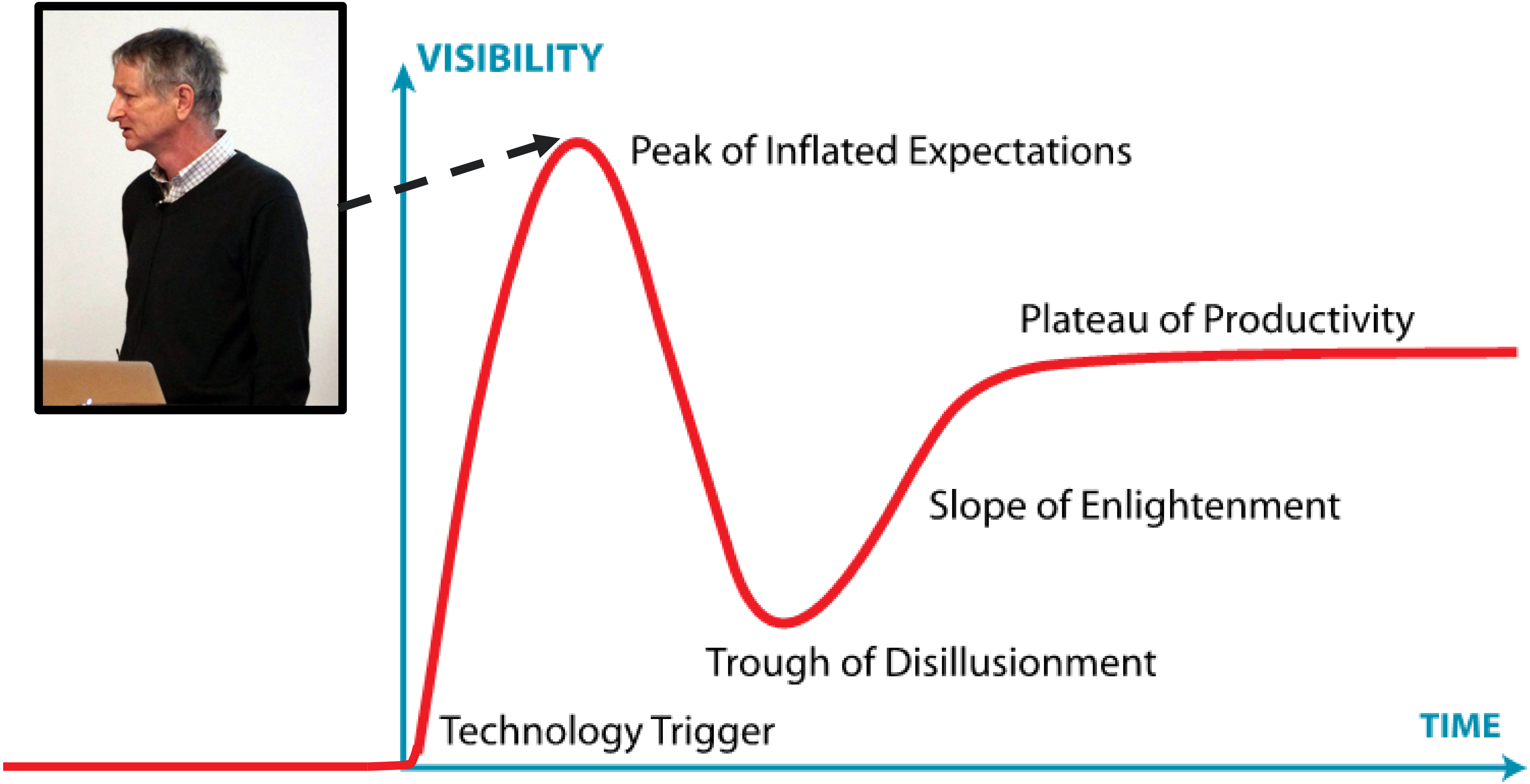
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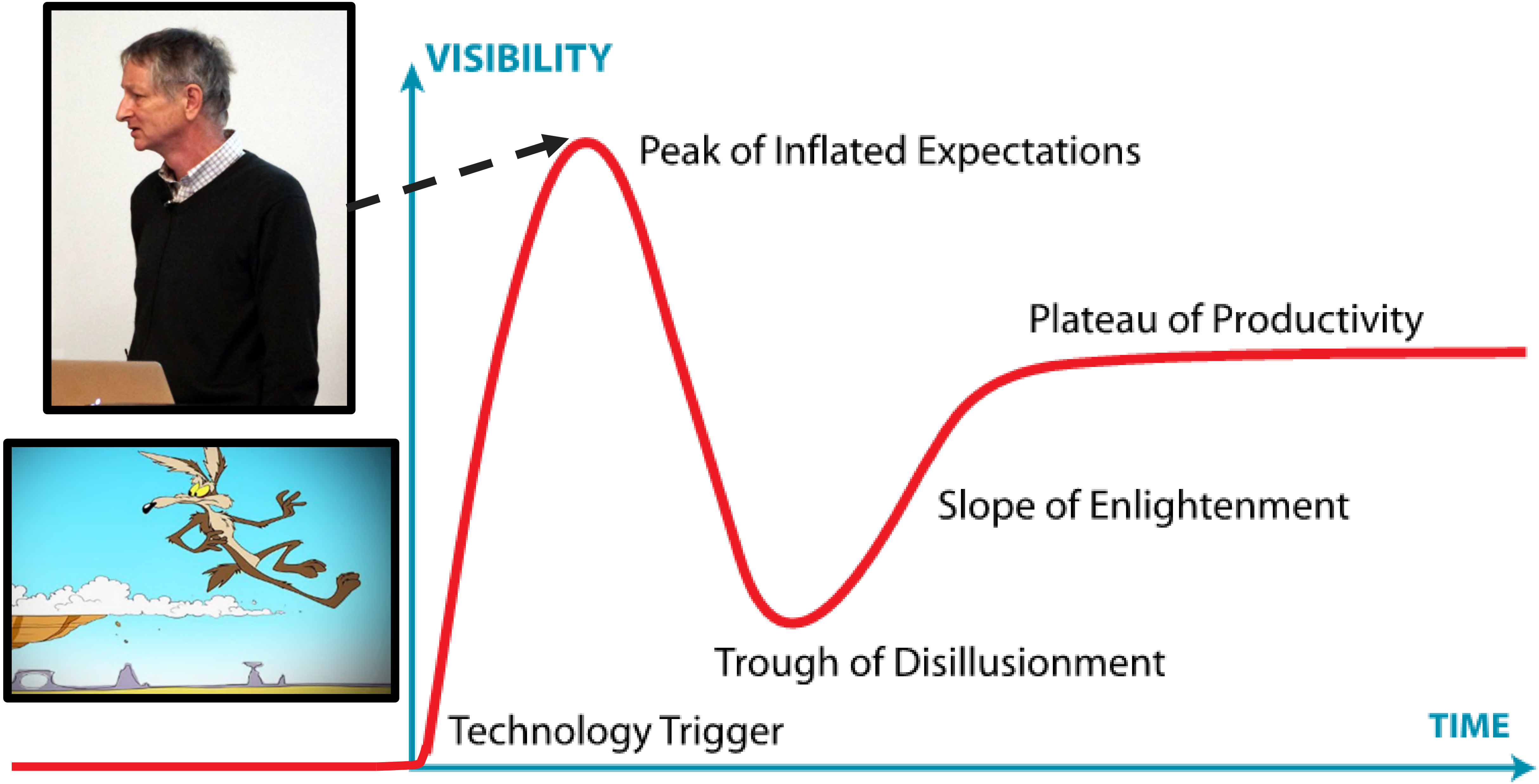
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"I think if you **work as a radiologist**, you're like the coyote that's **already over the edge of the cliff** but hasn't yet looked down, so doesn't know there's **no ground underneath him**…"

**Geoffrey Hinton, 2016**

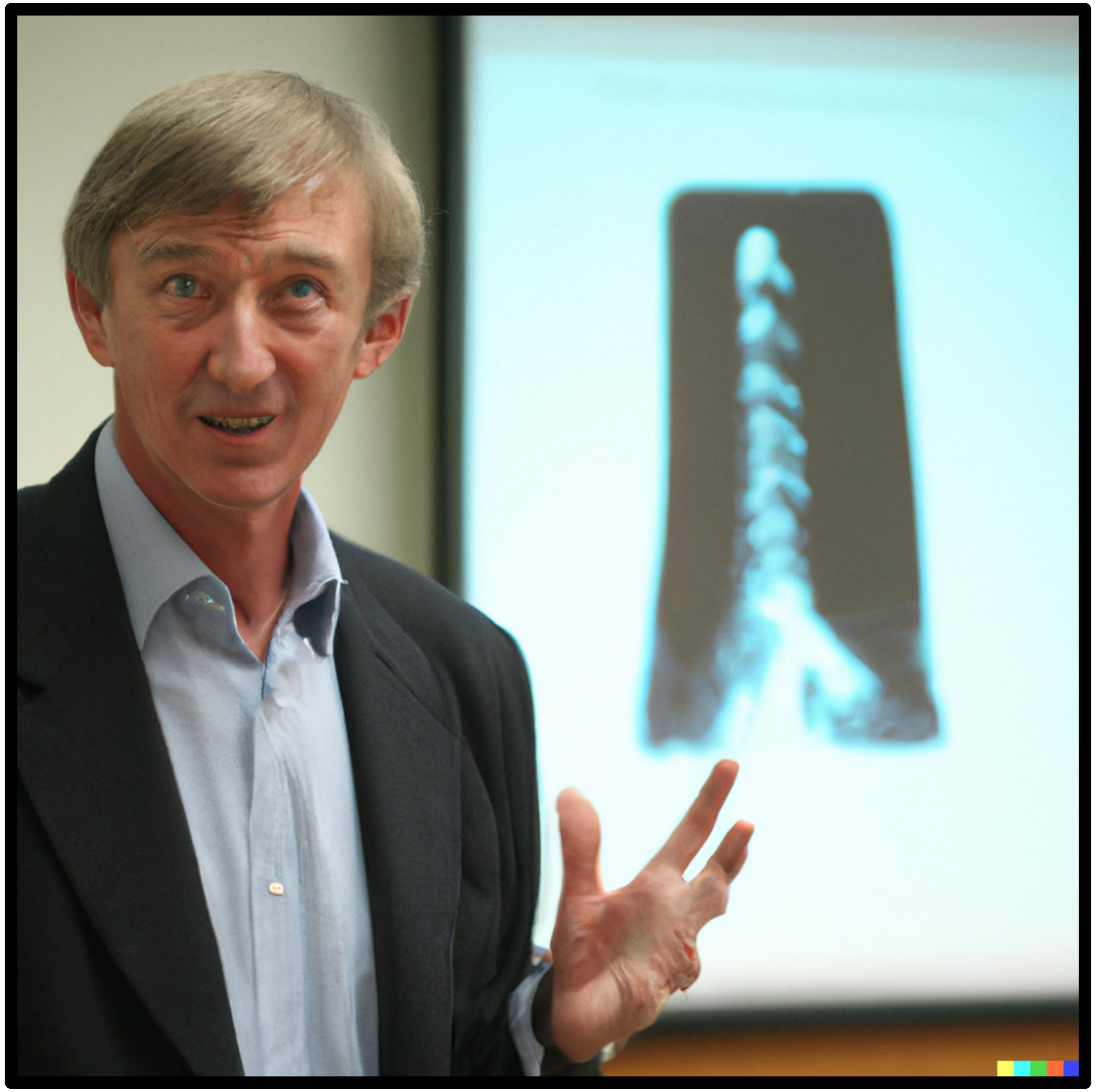
https://www.youtube.com/watch?v=2HMPRXstSvQ

“People should stop training radiologists now.

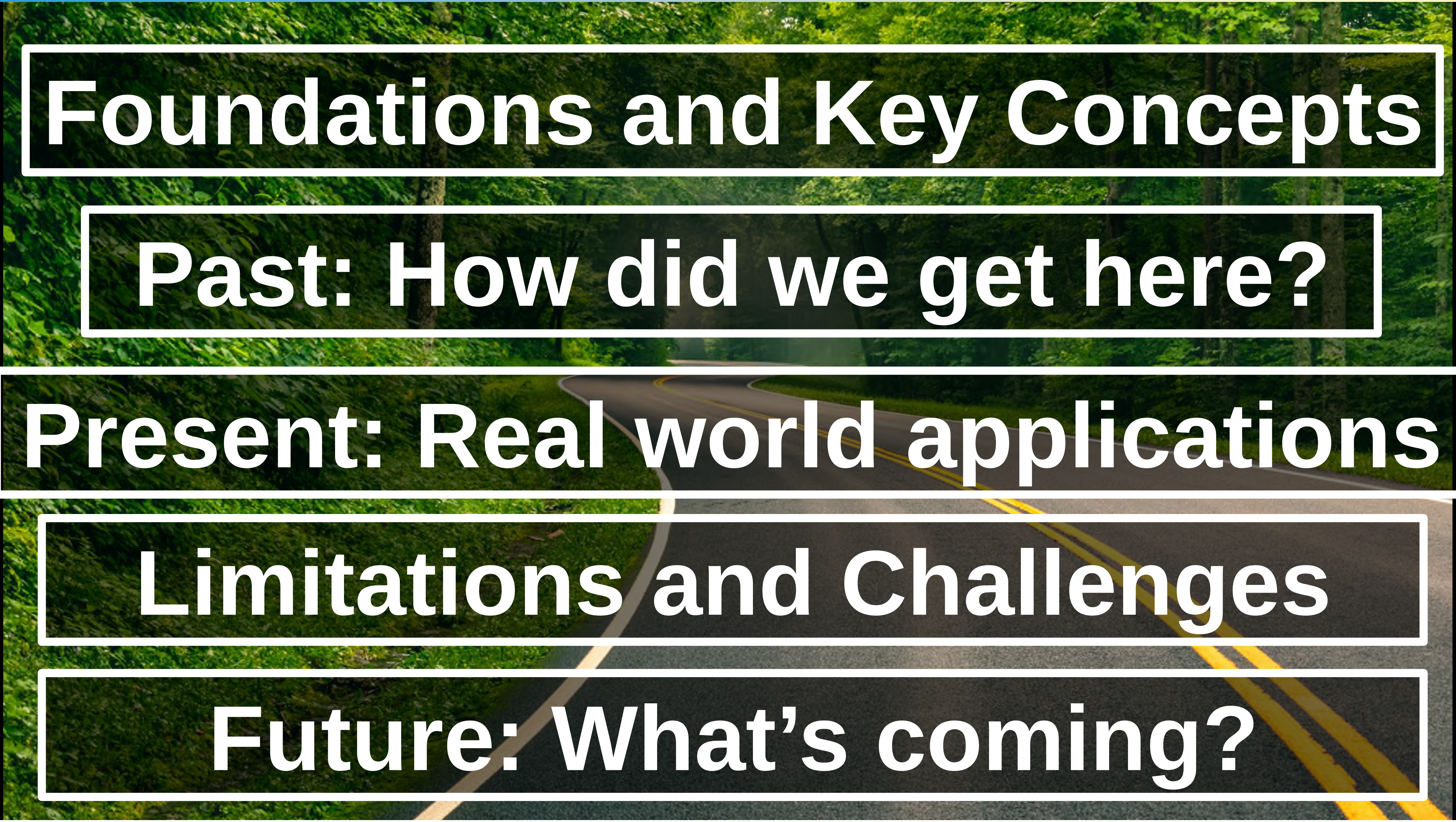
It's just completely obvious that within five years, deep learning is going to do better than radiologists.”

**Geoffrey Hinton, 2016**

https://www.youtube.com/watch?v=2HMPRXstSvQ



“Geoffrey Hinton speaking about radiology” Dall-E 2021


Foundations and Key Concepts
Past: How did we get here?
Present: Real world applications
Limitations and Challenges
Future: What’s coming?

## Foundations and Key Concepts

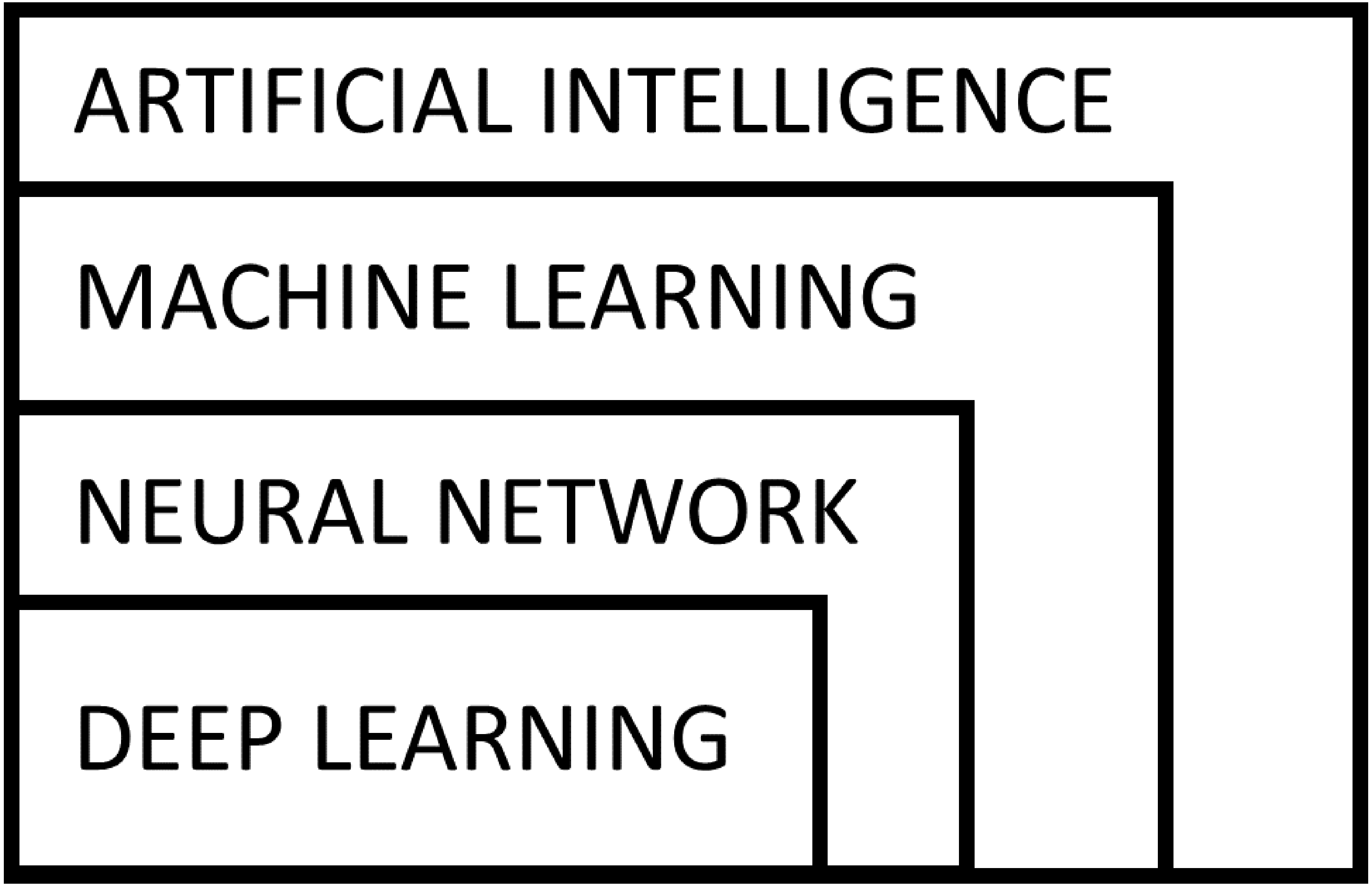
## Past: How did we get here?

## Present: Real world applications

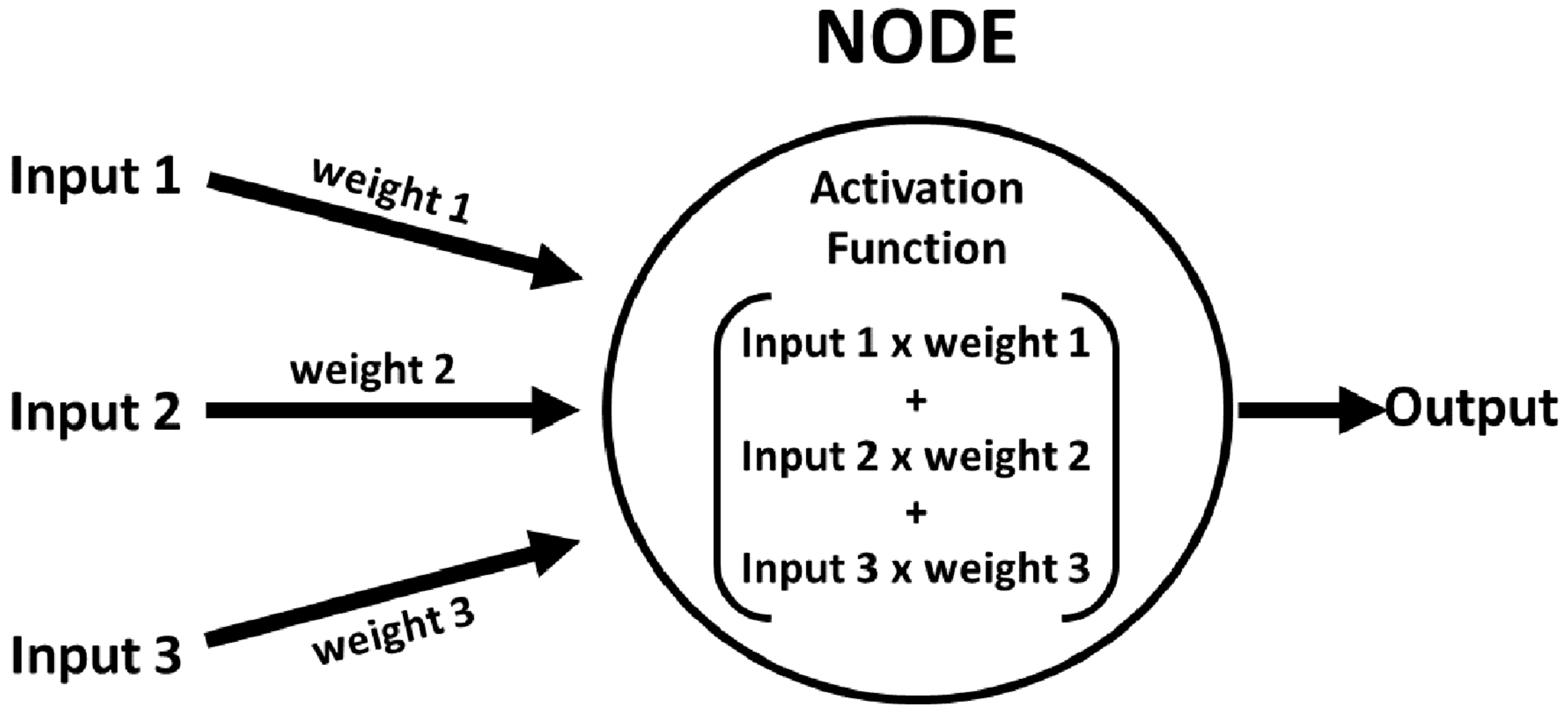
## Limitations and Challenges

## Future: What’s coming?

# Foundations & Key Concepts



# Neural Network



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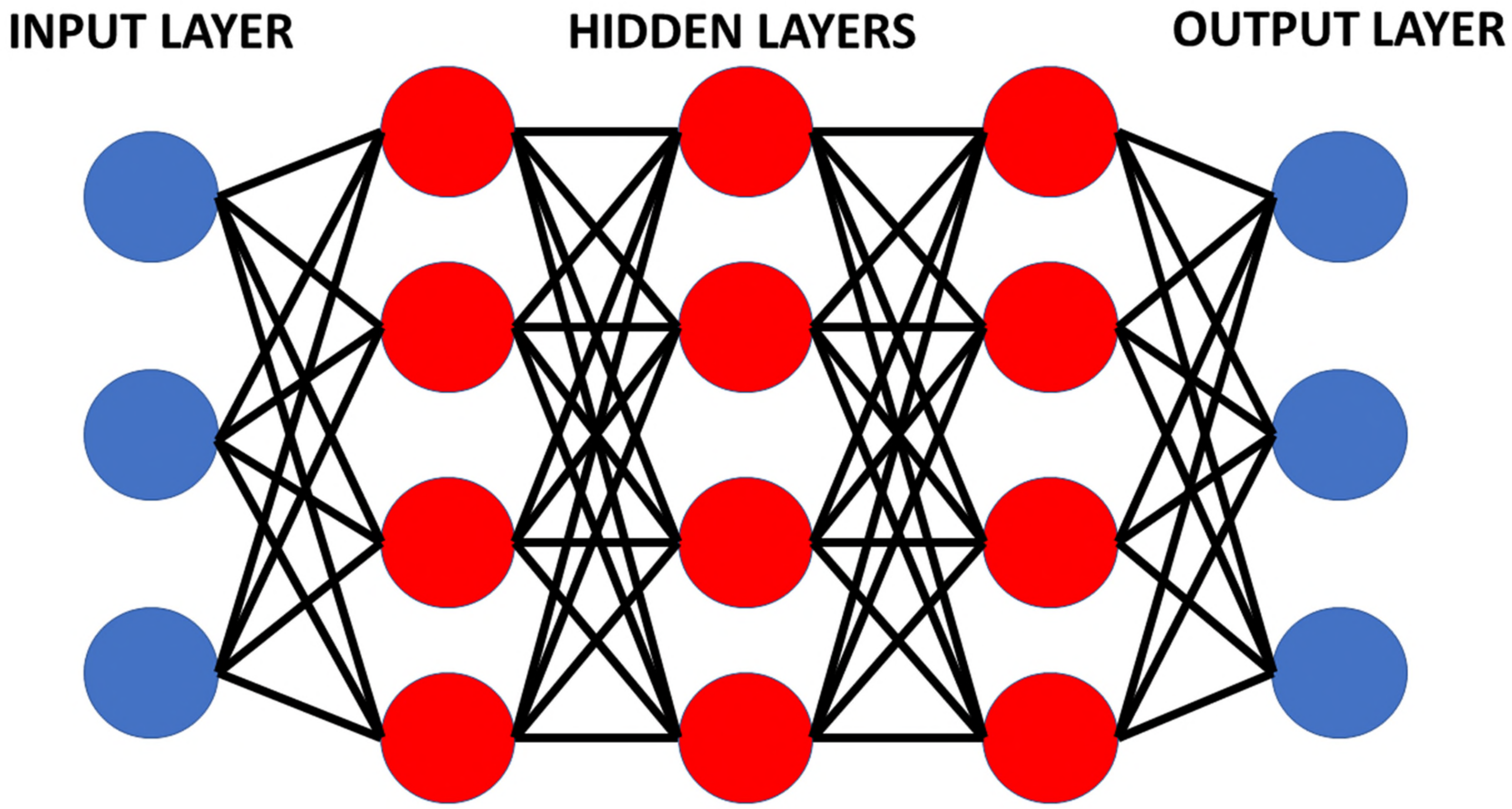
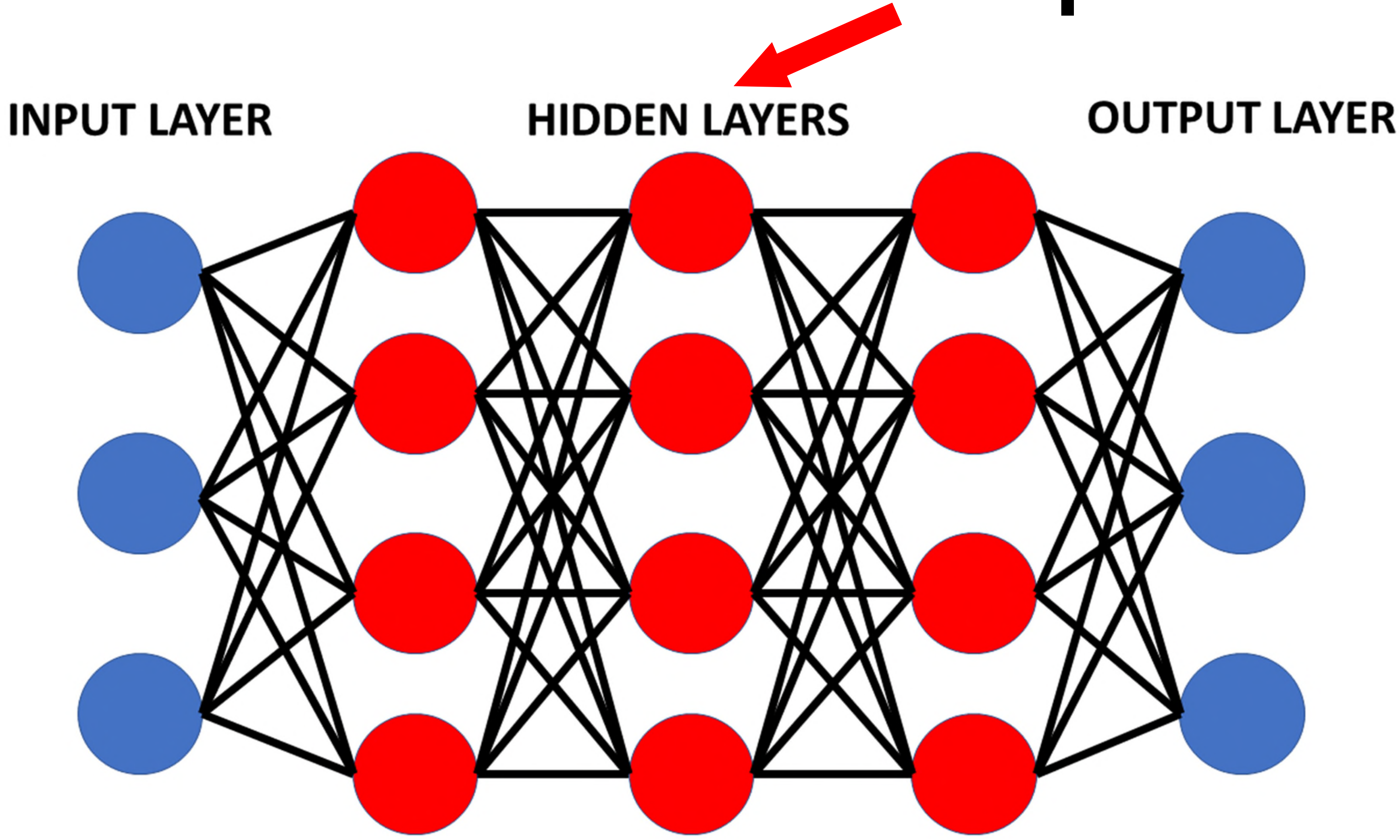
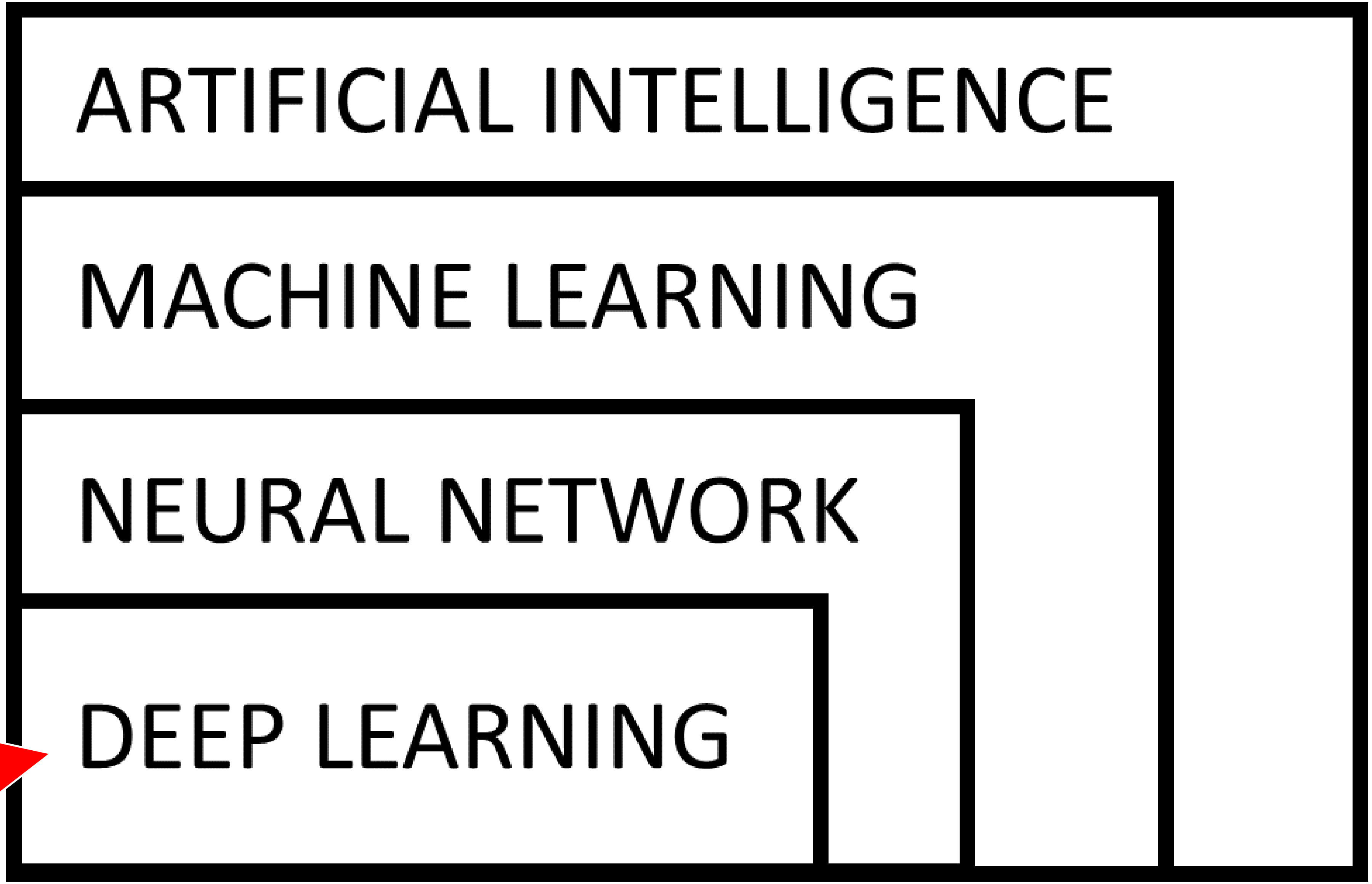
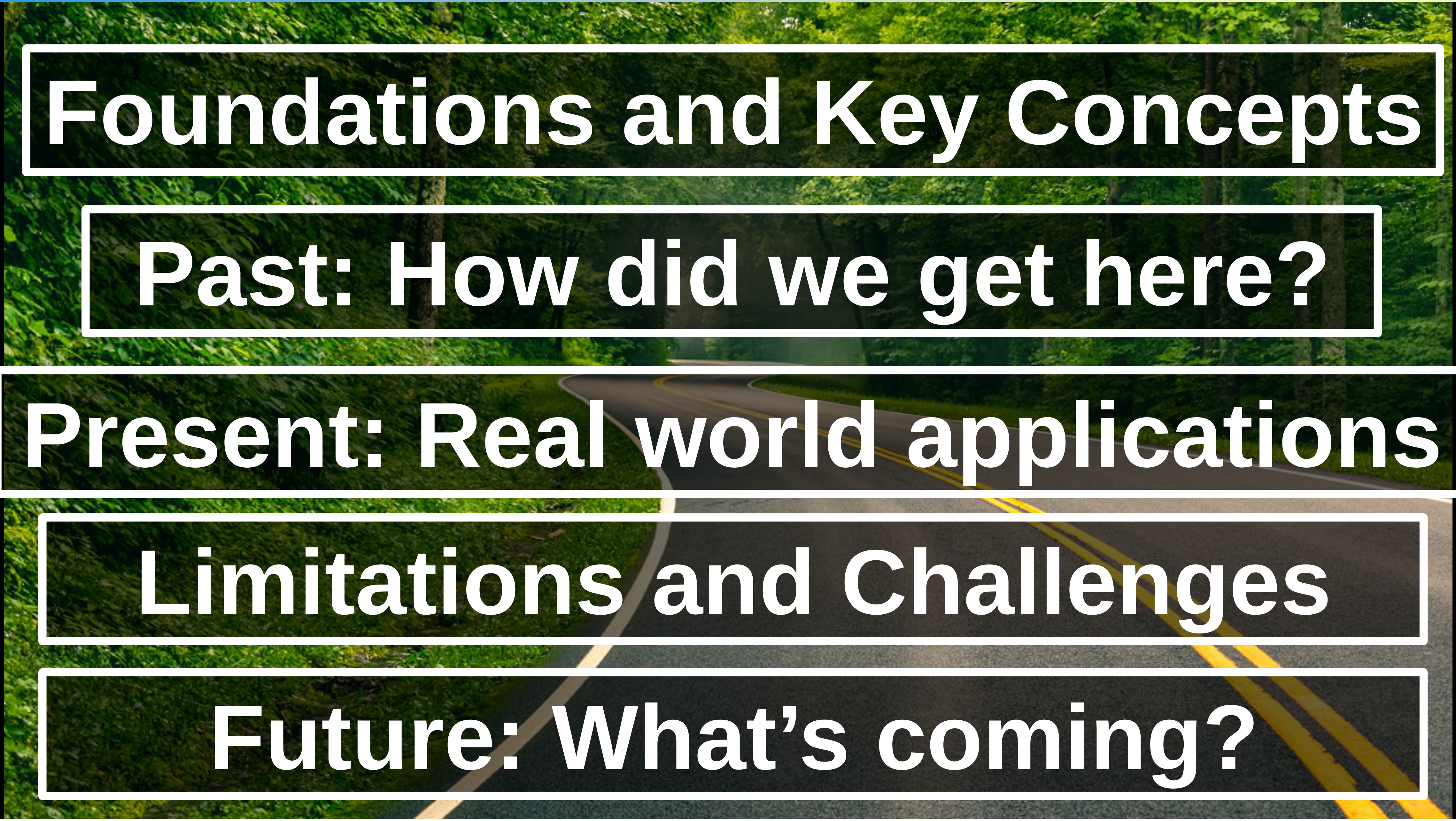


# Neural Network Deep Learning



# Foundations & Key Concepts





Foundations and Key Concepts

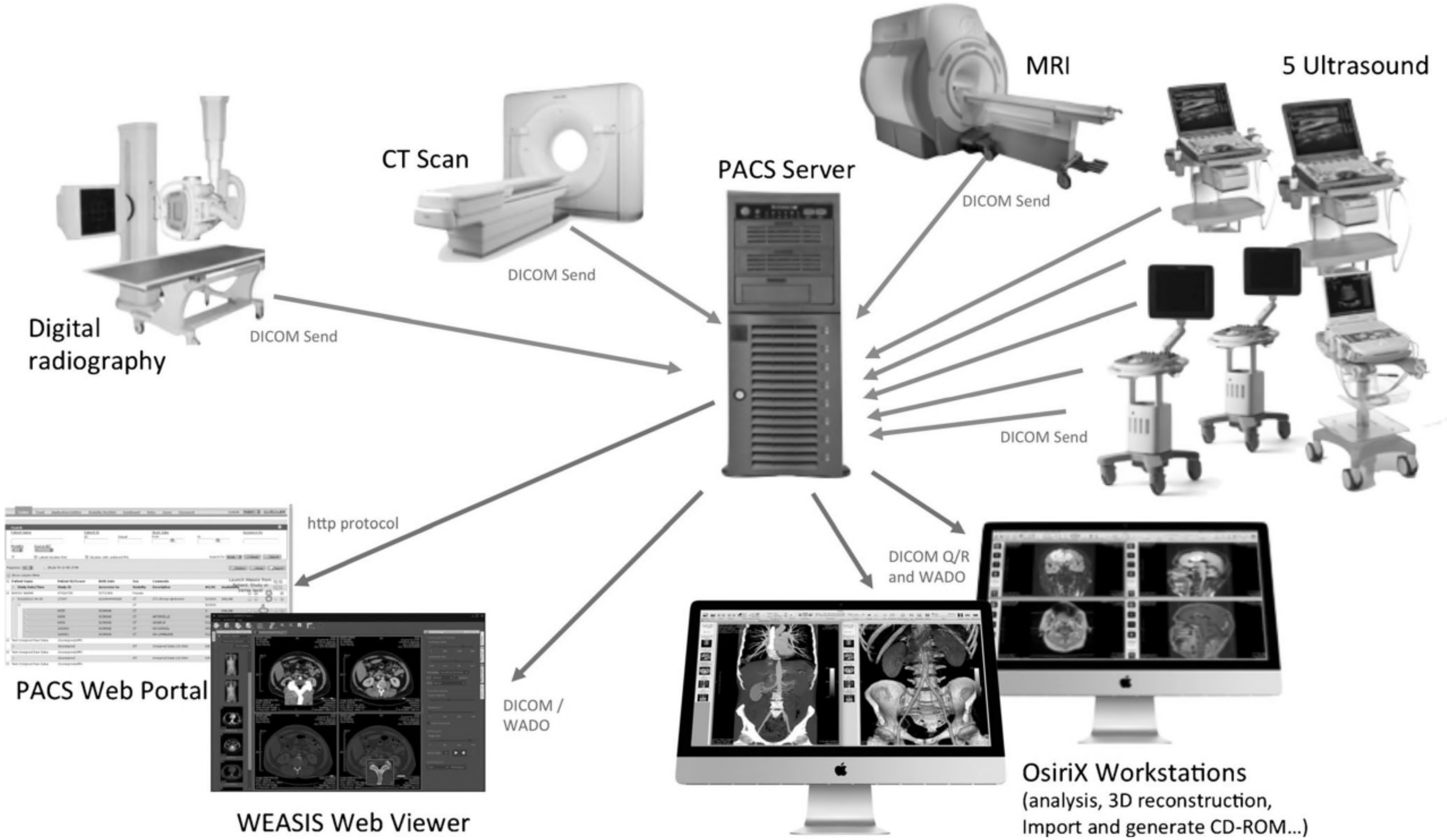
Past: How did we get here?

Present: Real world applications

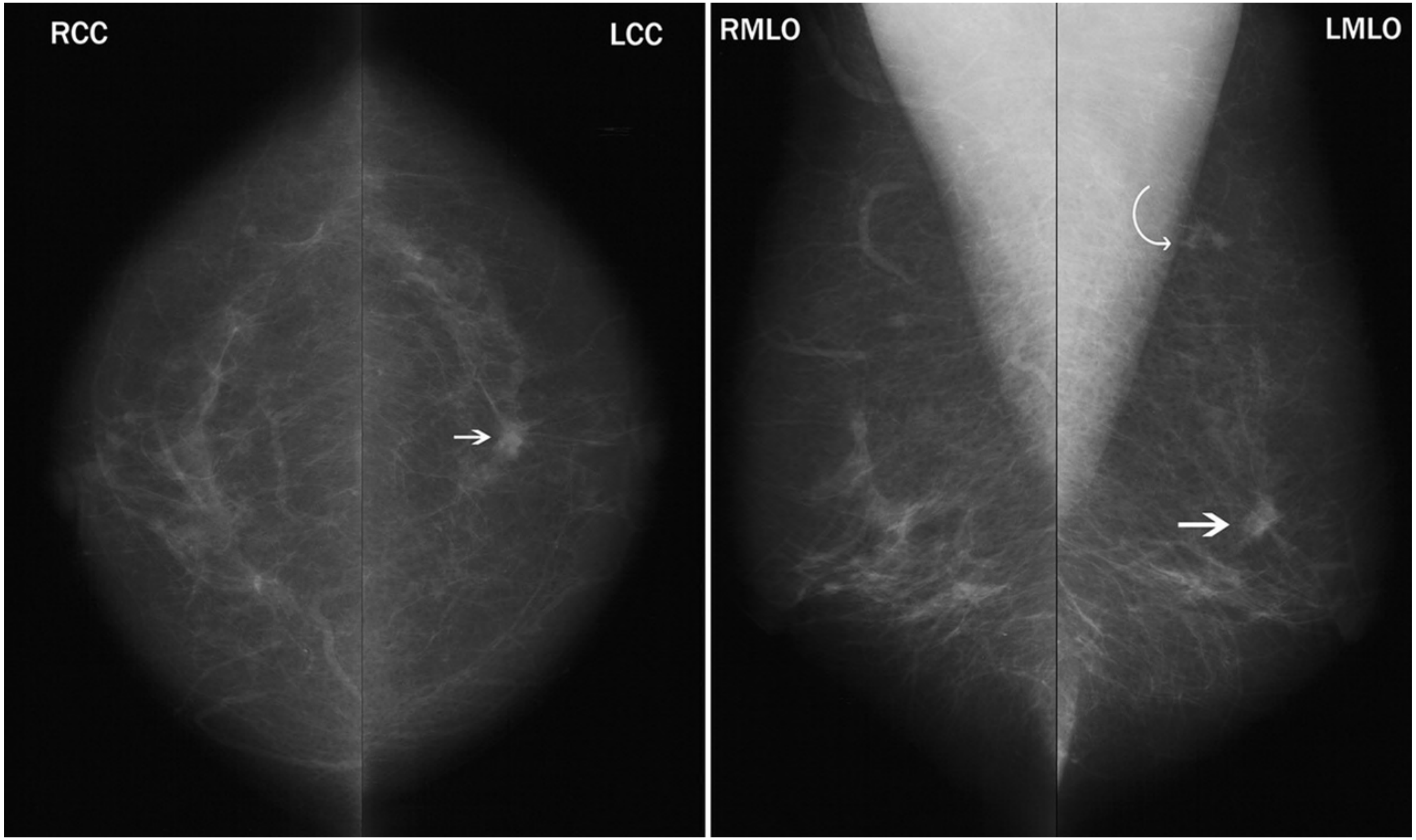
Limitations and Challenges

Future: What’s coming?

# The Past: Early CAD & Historical Lessons



# The Past: Early CAD & Historical Lessons




Morton et al. **Screening Mammograms: Interpretation with Computer-aided Detection—Prospective Evaluation. Radiology 2005**

**1998**

**FDA approval**

**2002**

**CMS pay**

**2000 – 2008**

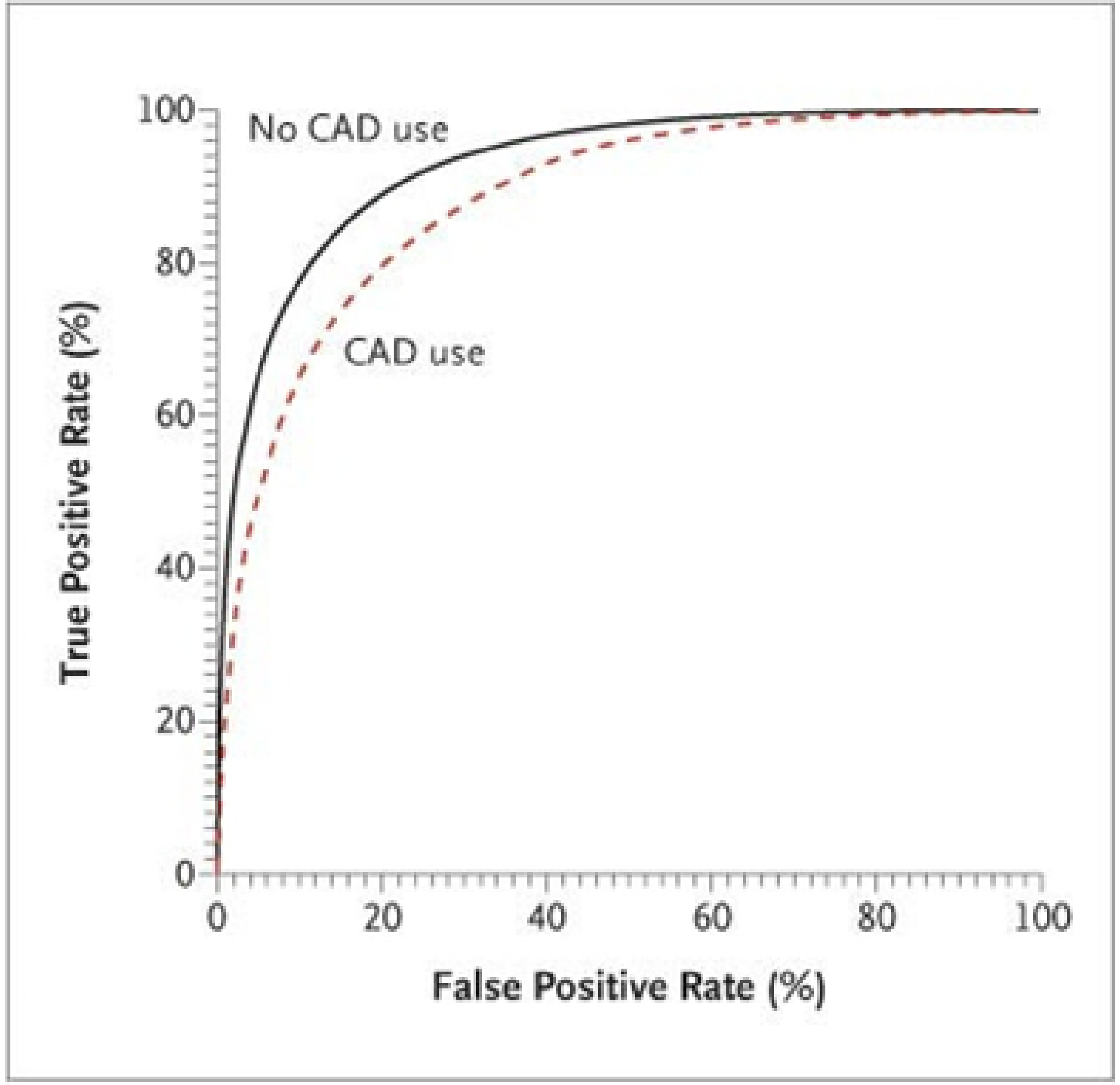
**Proliferation of PACS**

# The Past: Early CAD & Historical Lessons

Early studies show small increase in detection rates (2-10%) and earlier detection (2 months)

All small second reader studies

No outcomes evidence




Fenton JJ, et al. Influence of computer-aided detection on performance of screening mammography. N Engl J Med. 2007 Apr 5;356(14):1399-409.

**2007**

**Fenton, et al – large multi-institutional study showed increase in FP and potential overdiagnosis**

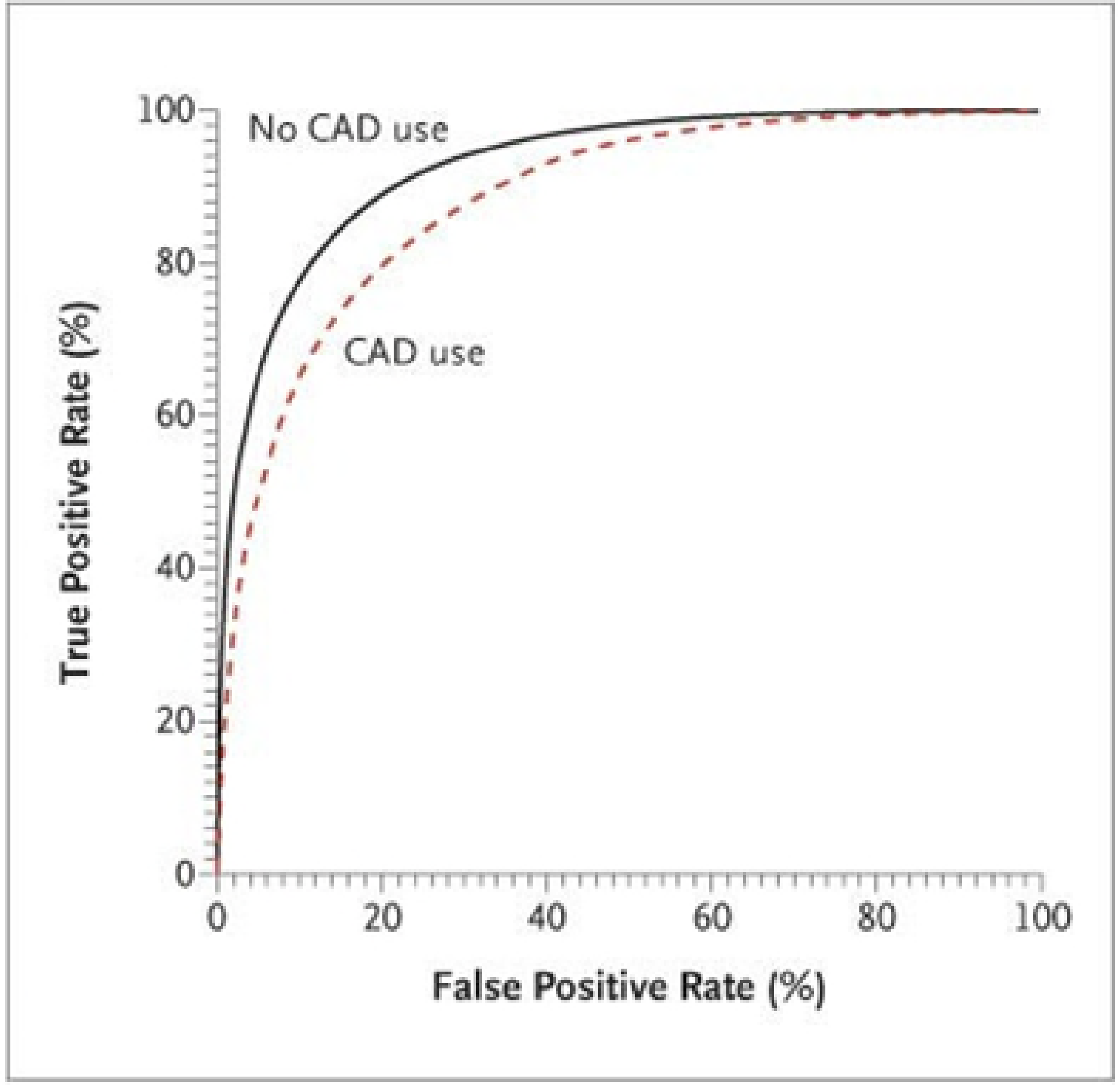
**2016**

**92% of imaging facilities used CAD**

**2018**

**Medicare ceased add-on payments for CAD**

# Why did CAD fail?




Fenton JJ, et al. Influence of computer-aided detection on performance of screening mammography. N Engl J Med. 2007 Apr 5;356(14):1399-409.

”Second reader” - not all readers are the same!

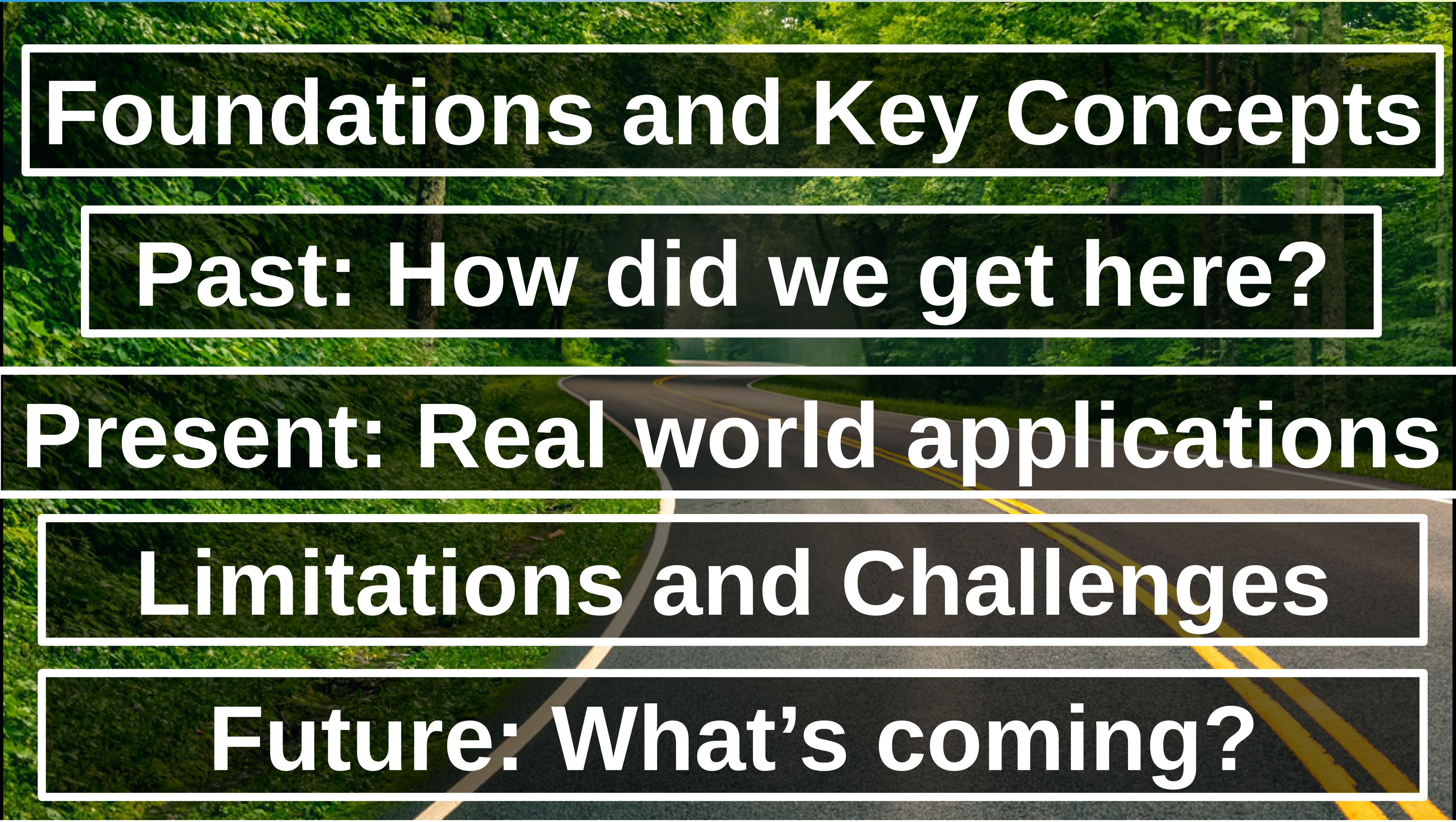
True positives < False positives

False sense of security

Trained supervision of algorithms

Lack of processing power

Cost without improved outcomes



# Foundations and Key Concepts

# Past: How did we get here?

# Present: Real world applications

# Limitations and Challenges

# Future: What’s coming?

# The Present: Real-World Applications

1,247 FDA approved clinical AI algorithms

*as of May 30, 2025

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>1000 Related to medical imaging

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# The Present: Real-World Applications

| | |
|---|---|
| 1,247 | FDA approved clinical AI algorithms |
| >1000 | Related to medical imaging |
| 956 | Radiology-based |

*as of May 30, 2025

# The Present: Real-World Applicatio

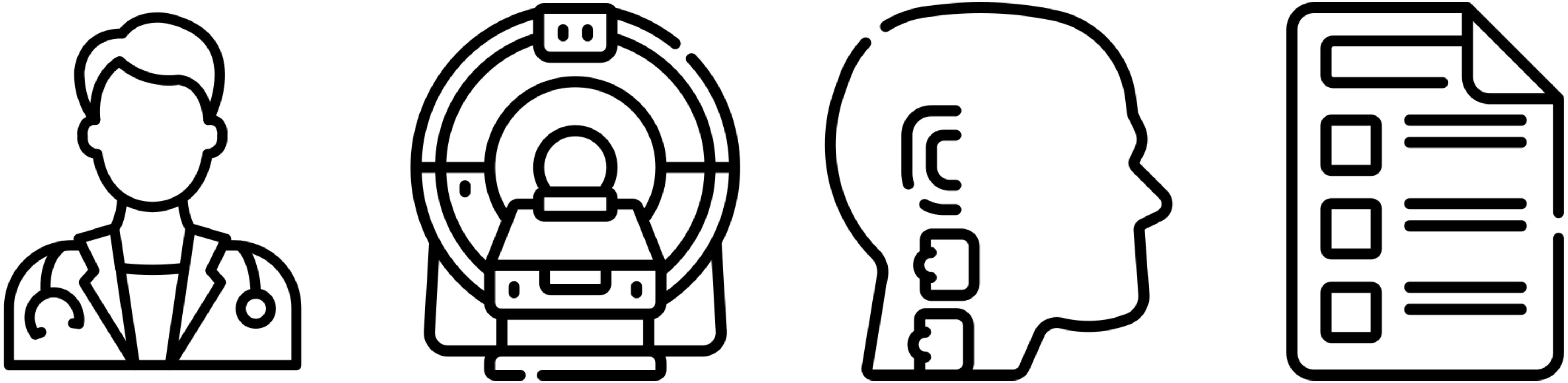
1,247 FDA approve … thms

>1000 … maging

956 … -based

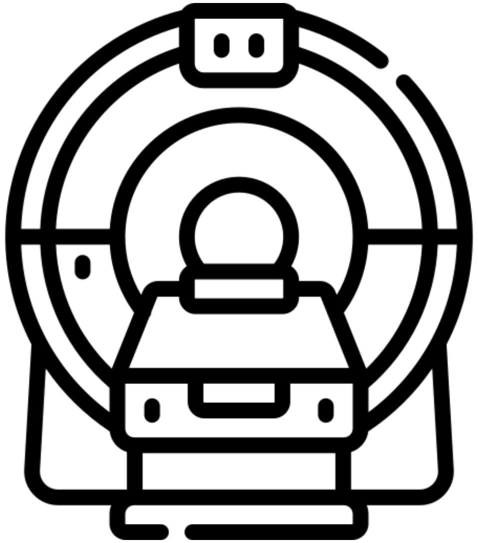
Lack of CPT codes – limited or no funding

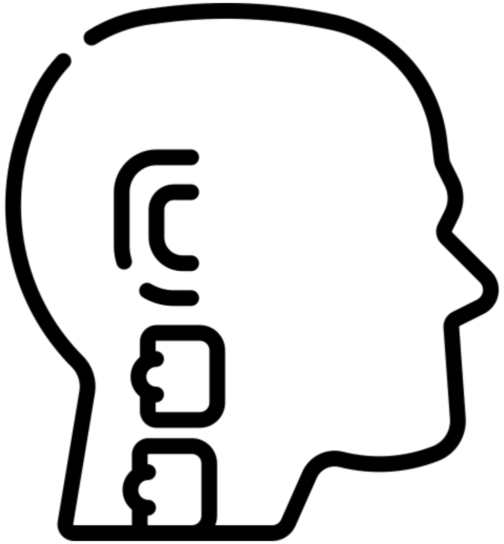
*as of May 30, 2025

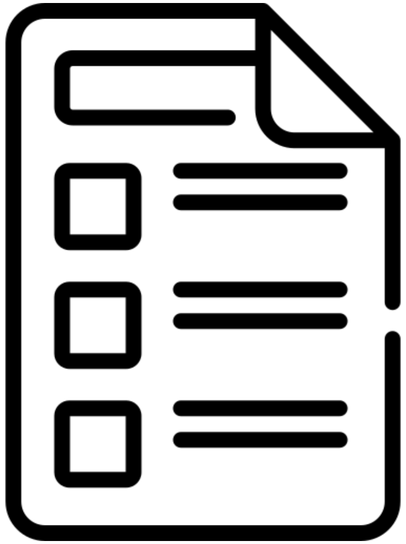


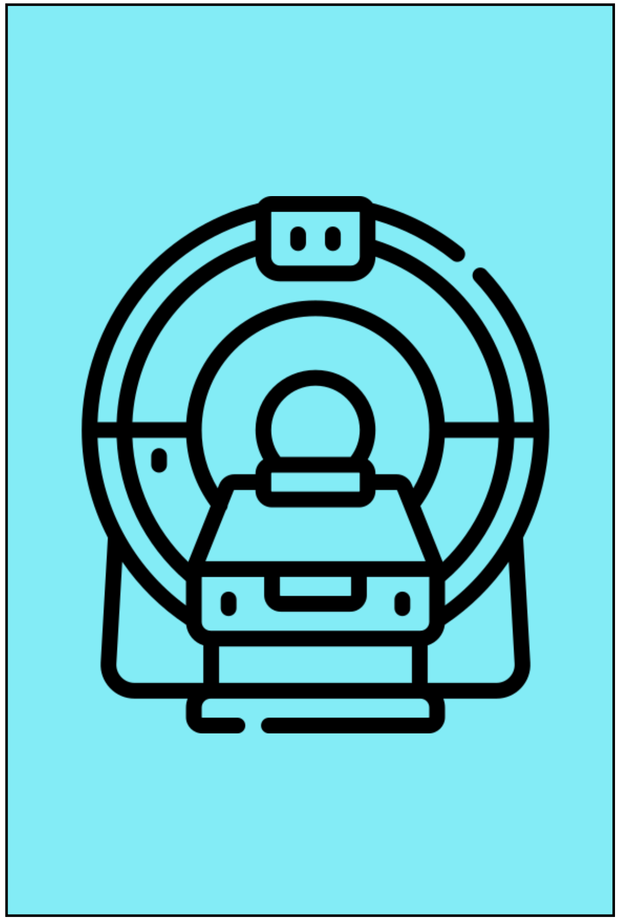
# Radiology Workflow Pipeline

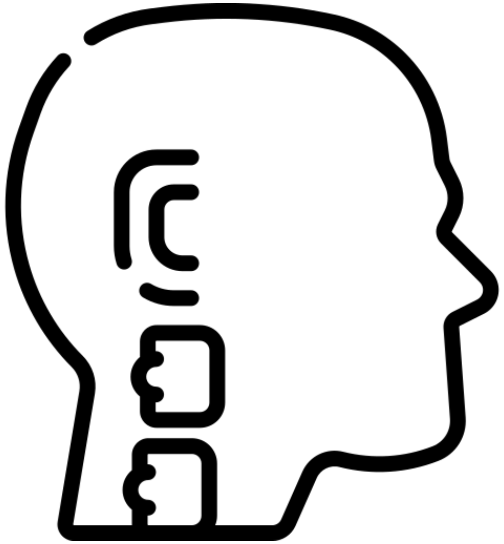
**_Imaging Order_**











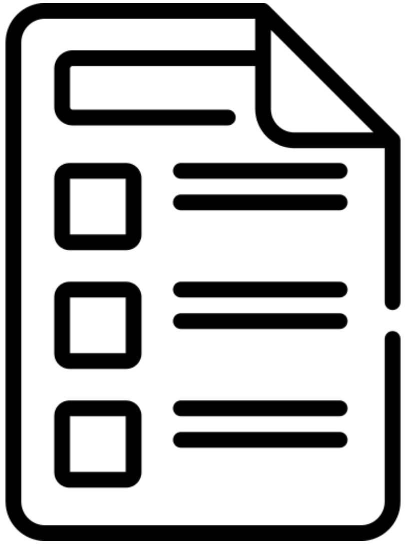
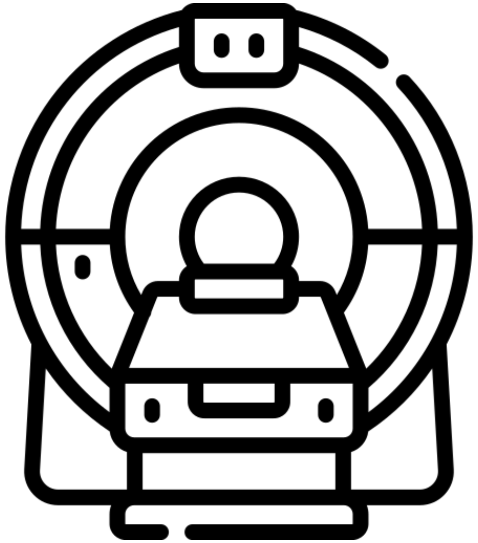
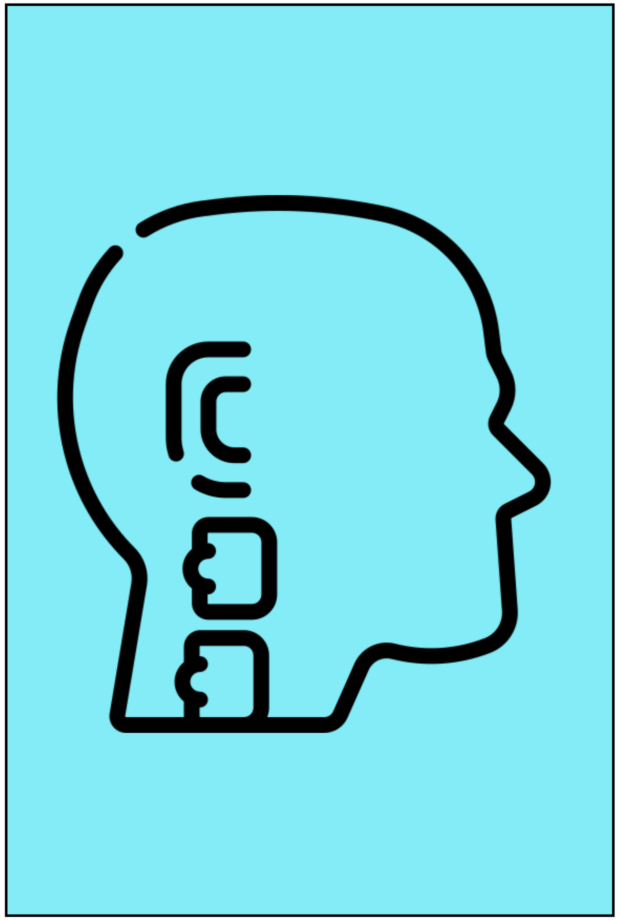


***Image Acquisition***





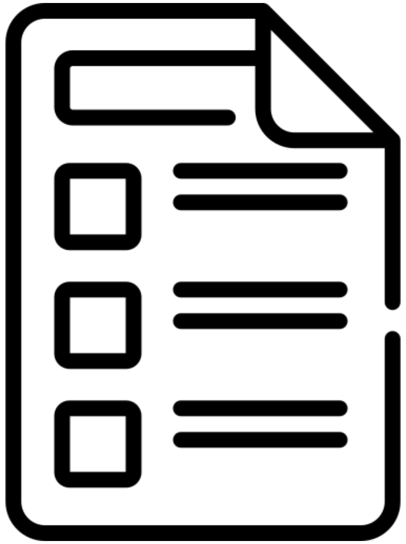
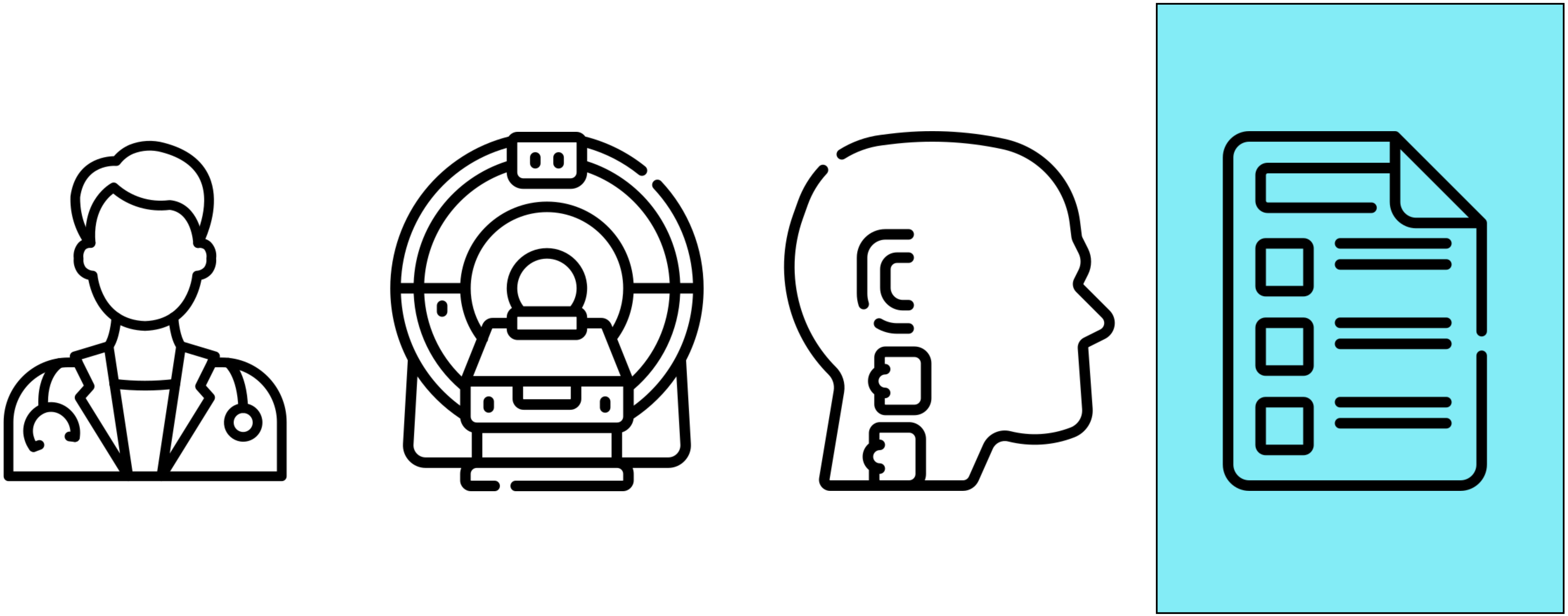
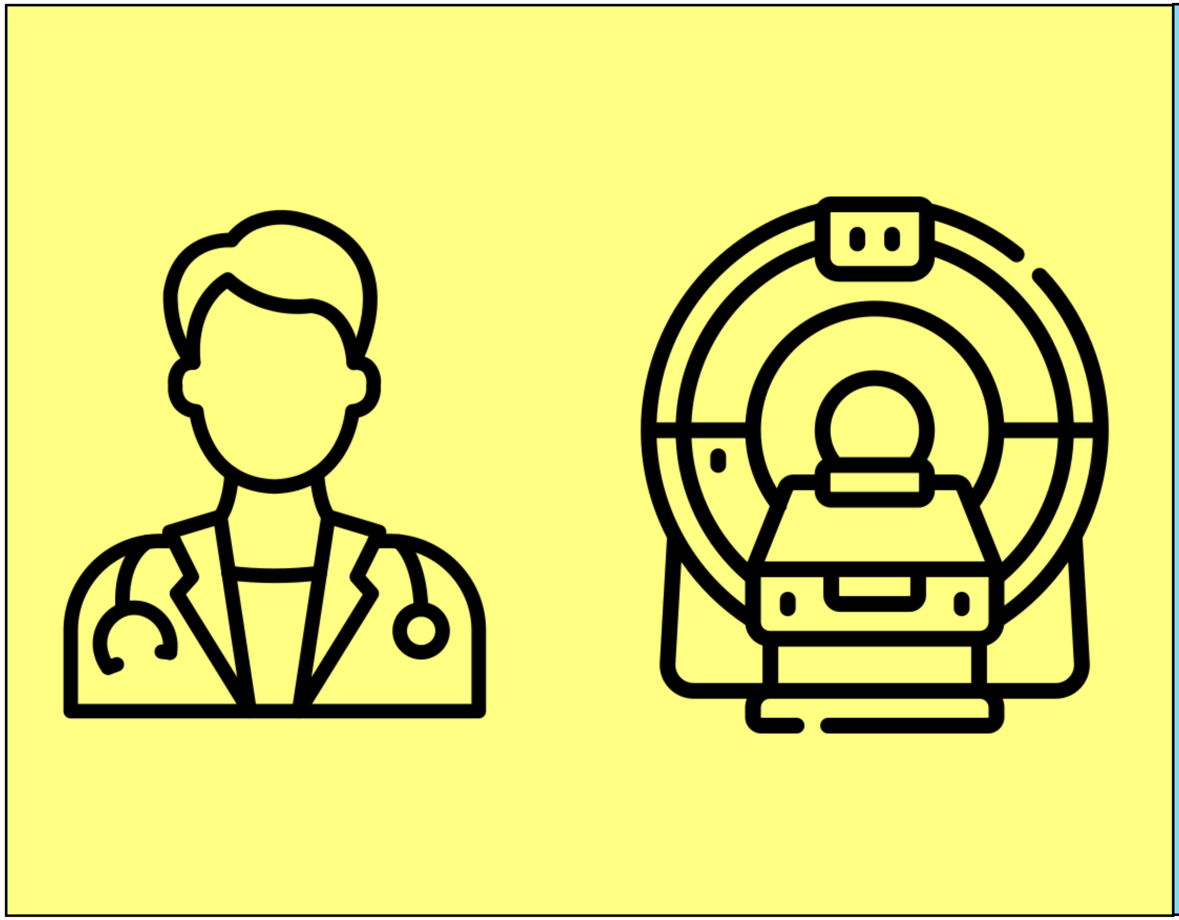
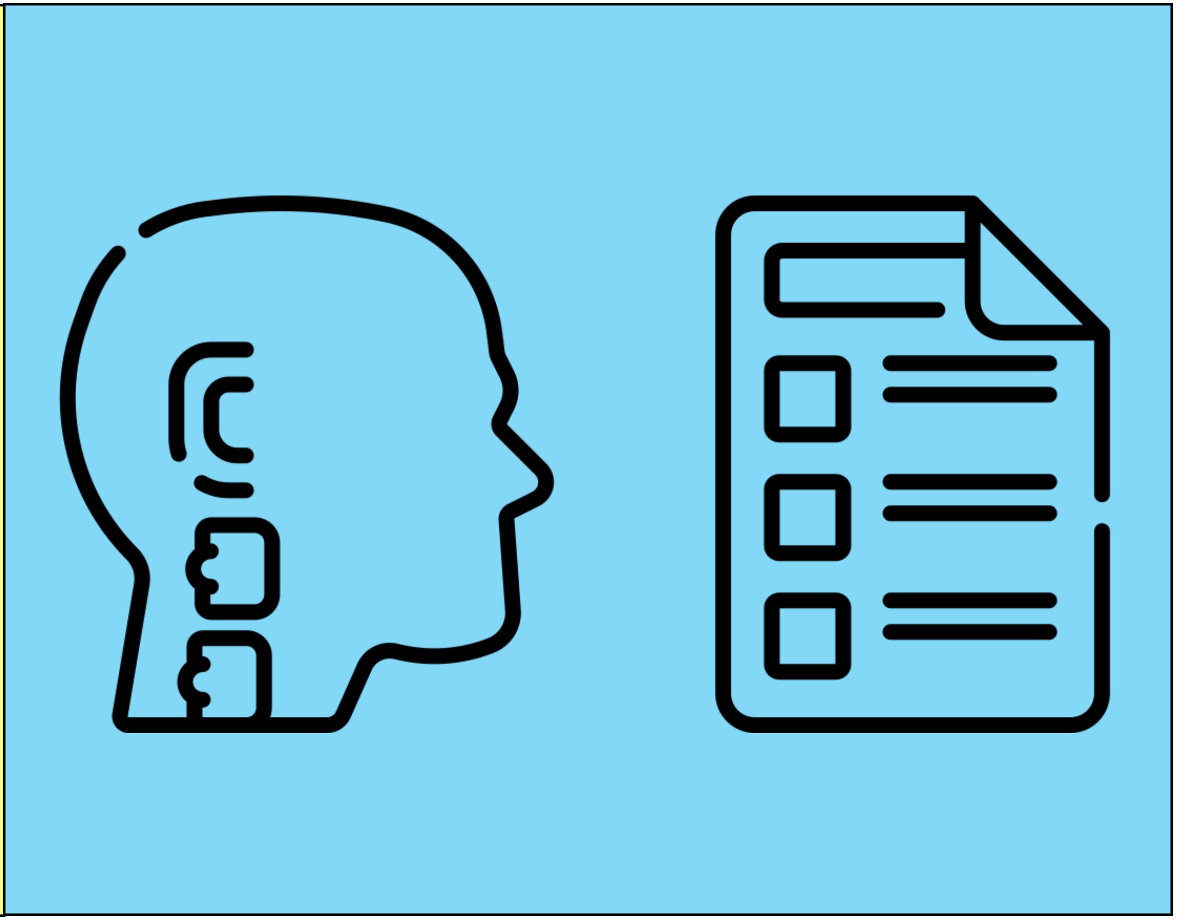


***Image Interpretation***

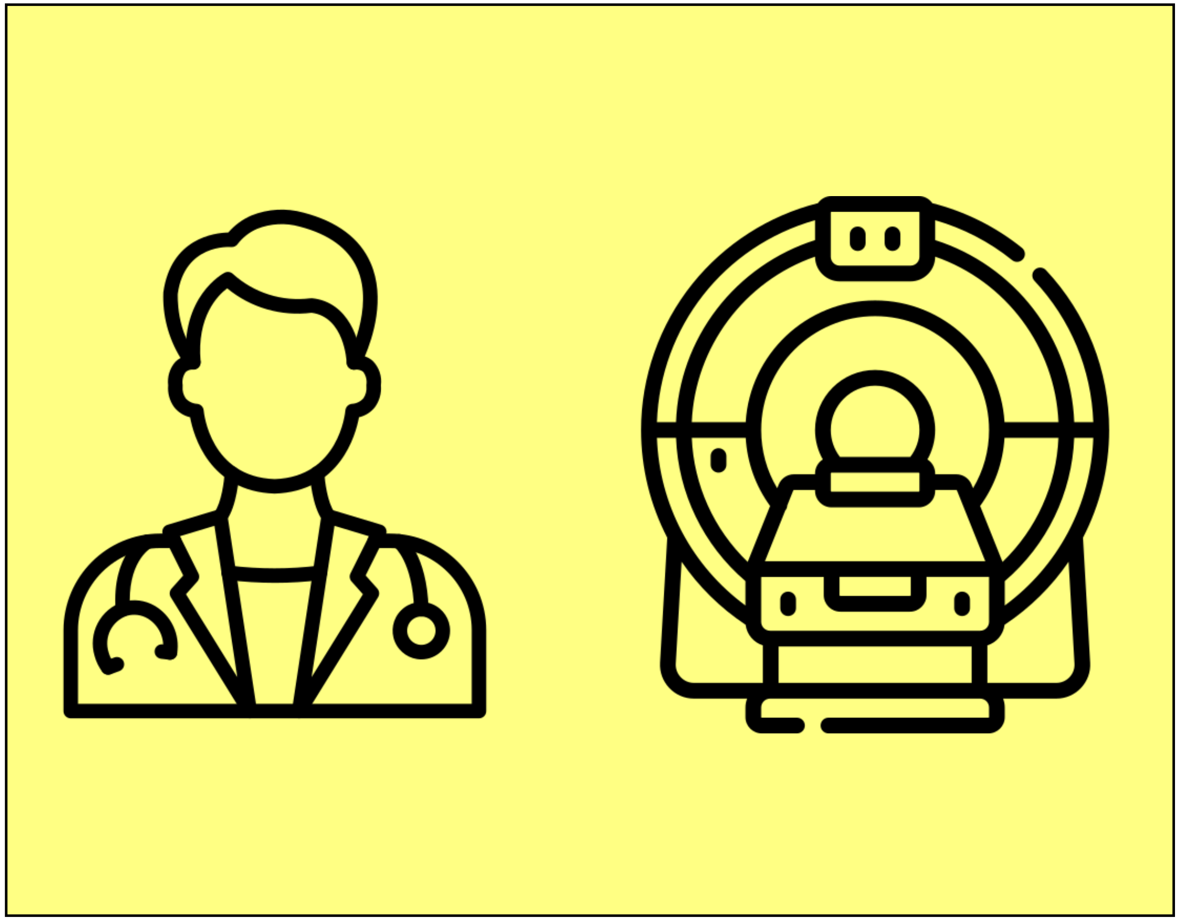


**Report Generation**





**Upstream Processes** **Downstream Processes**



*Upstream Processes*

Clinical decision support

Scheduling

Protocoling

Acquisition guidance

Quality standardization

Image optimization

Post processing

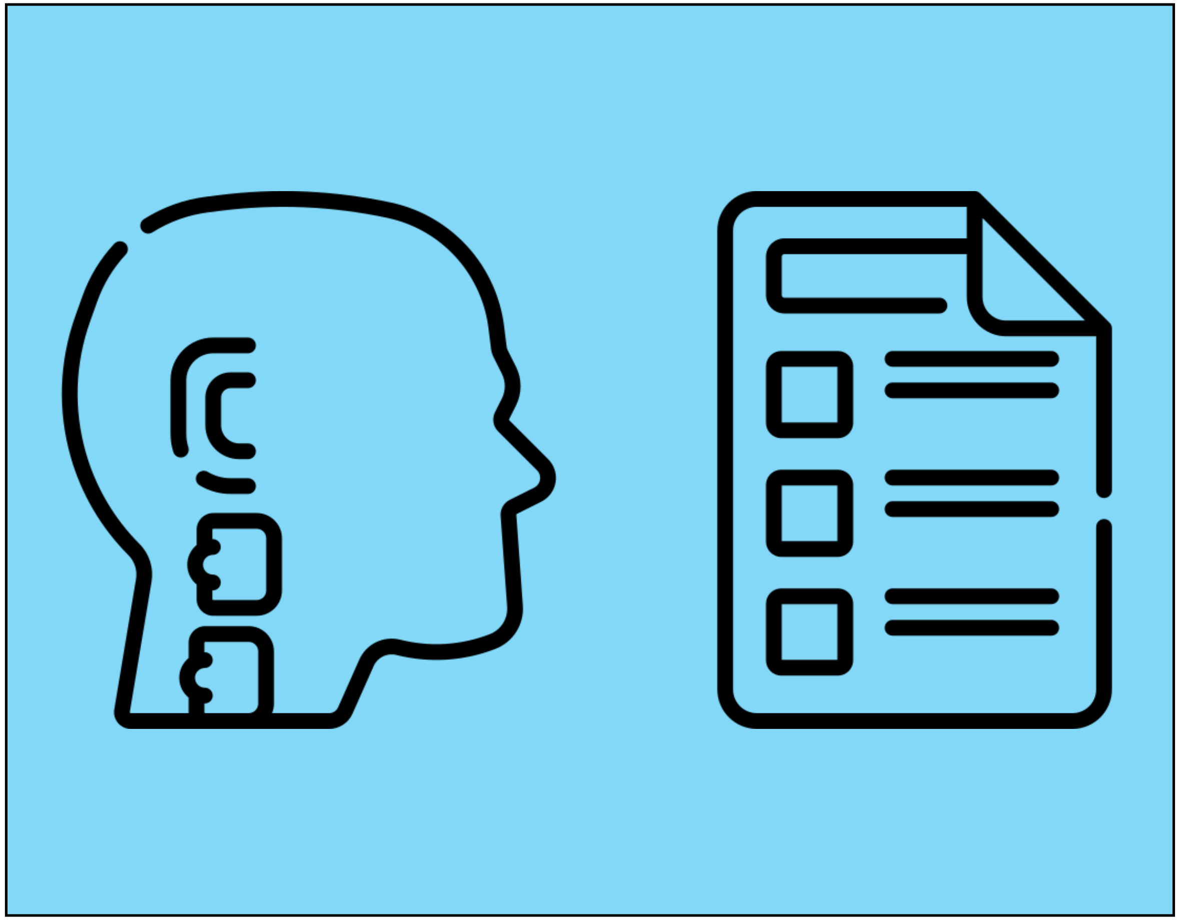
Worklist optimization

Segmentation

Treatment planning

Radiomics

Natural language processing



## ***Downstream Processes***

**Right study at the right time**

**Increased regulatory focus on ‘quality’**

**Increase high value imaging, decrease low value imaging**

**Clinical decision support**

Scheduling

Protocoling

Acquisition guidance

Quality standardization

Image optimization

Post processing

Worklist optimization

# Can an AI clinical decision support (CDS) tool improve the rate of structured indication entries and scored orders?

Shreve LA, Fried JG, Liu F, et al. *J Am Coll Radiol*. 2023;20

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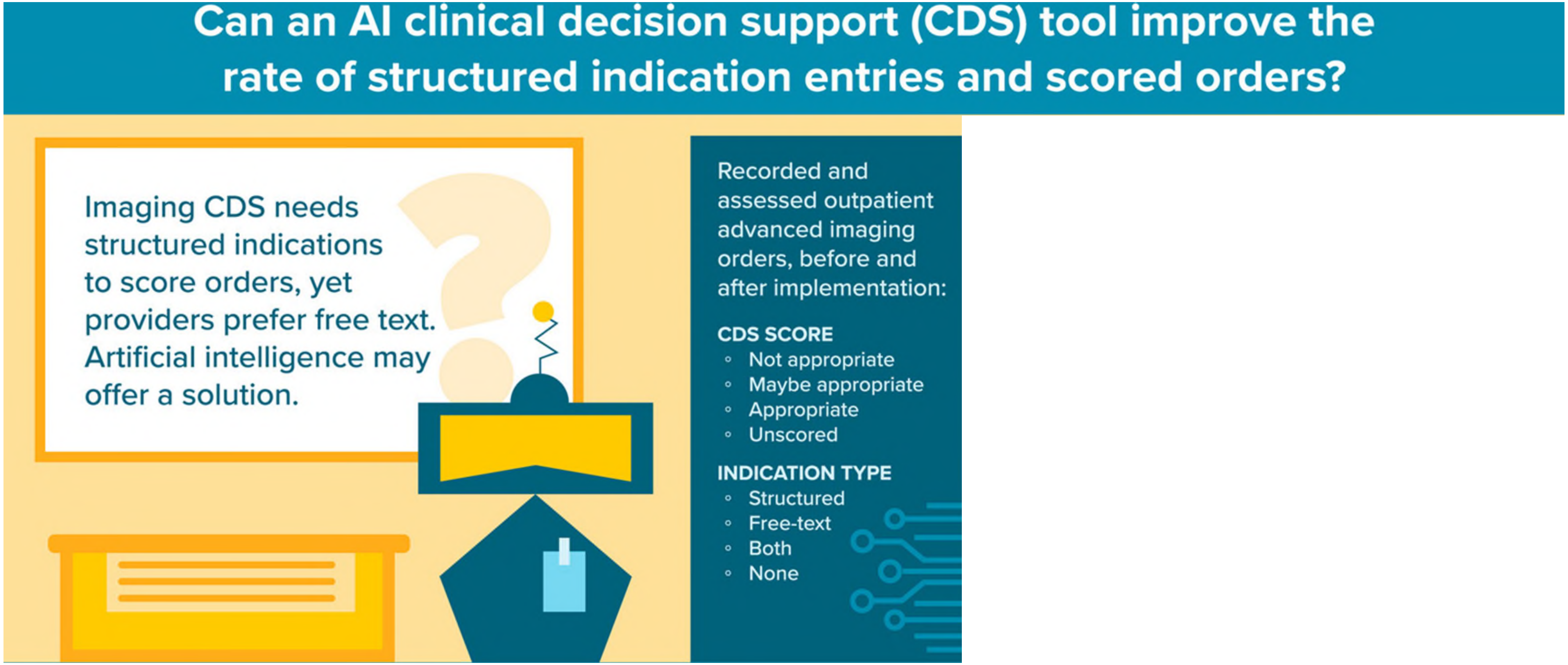


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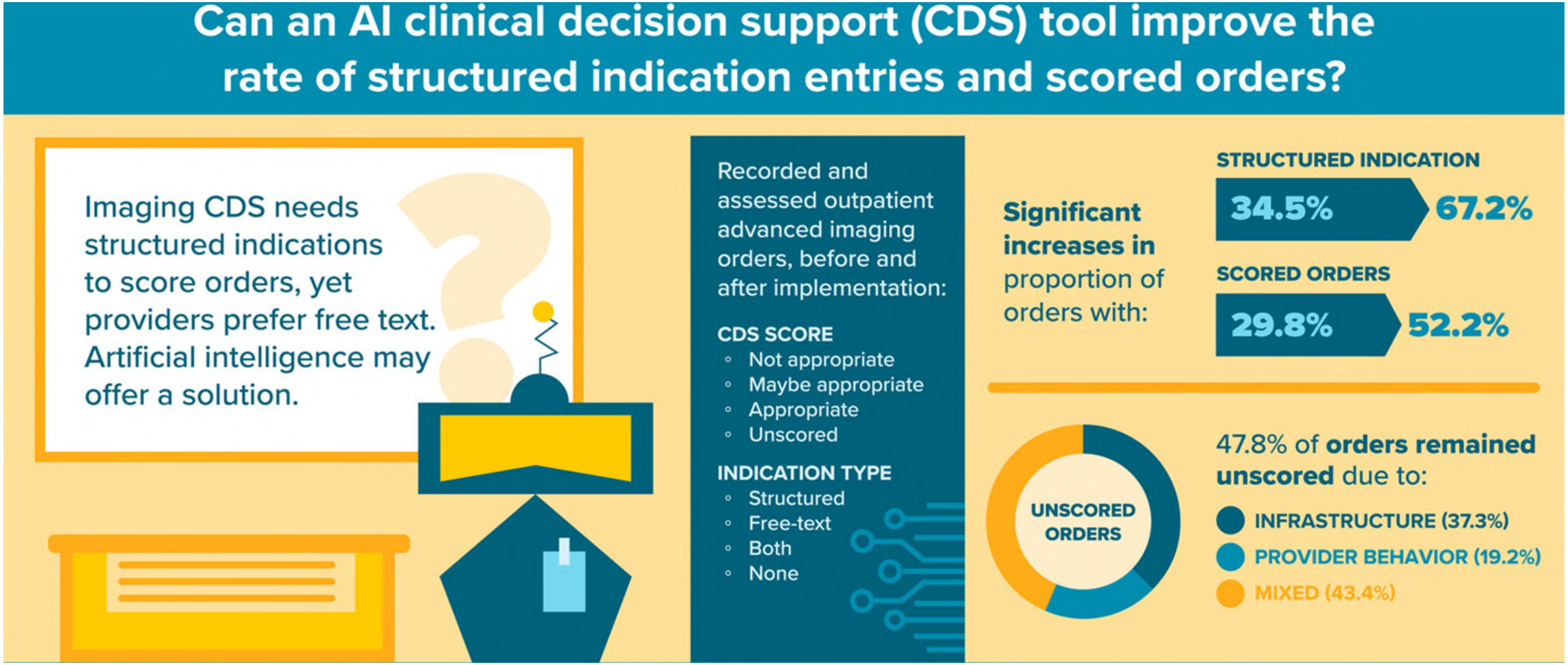


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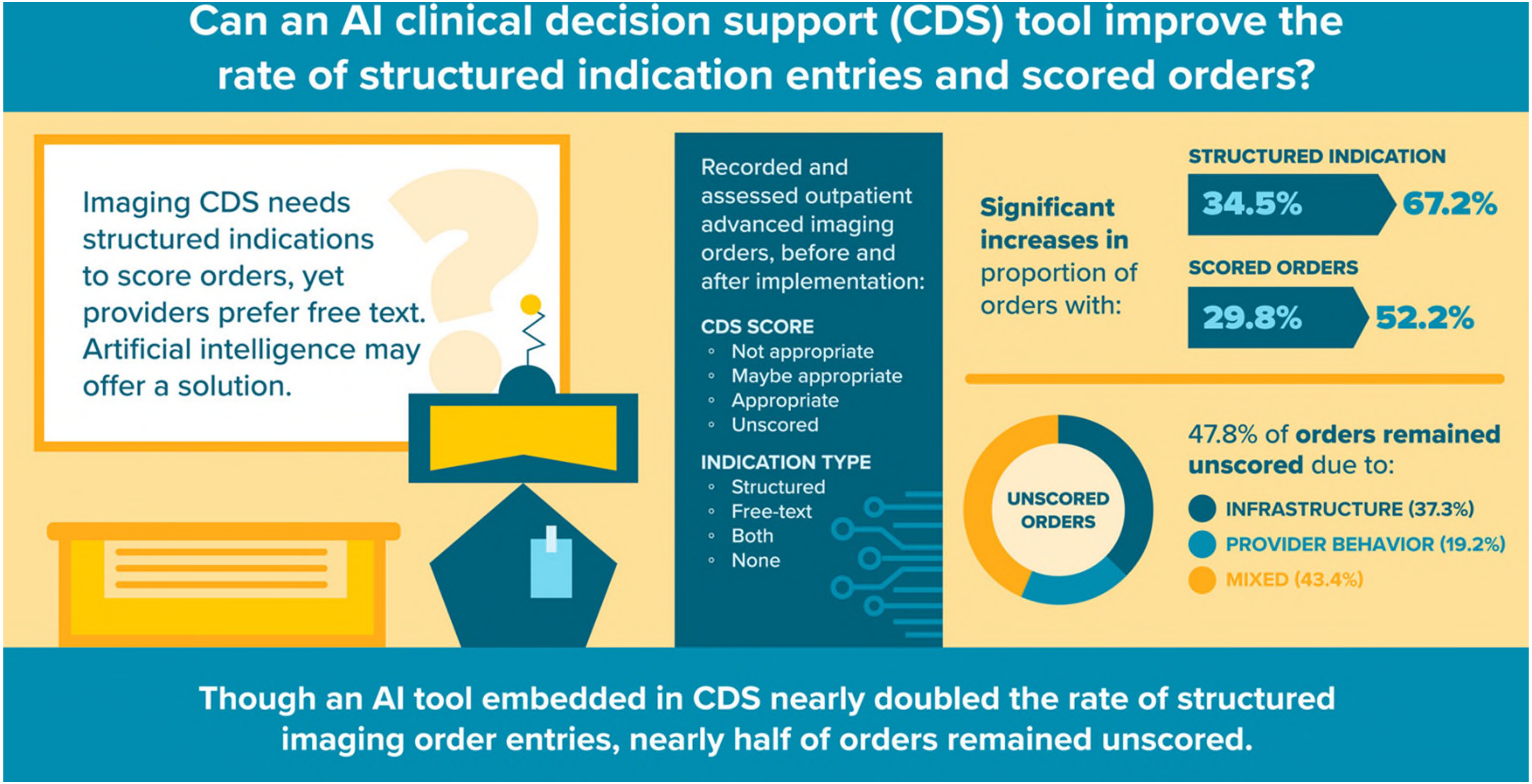
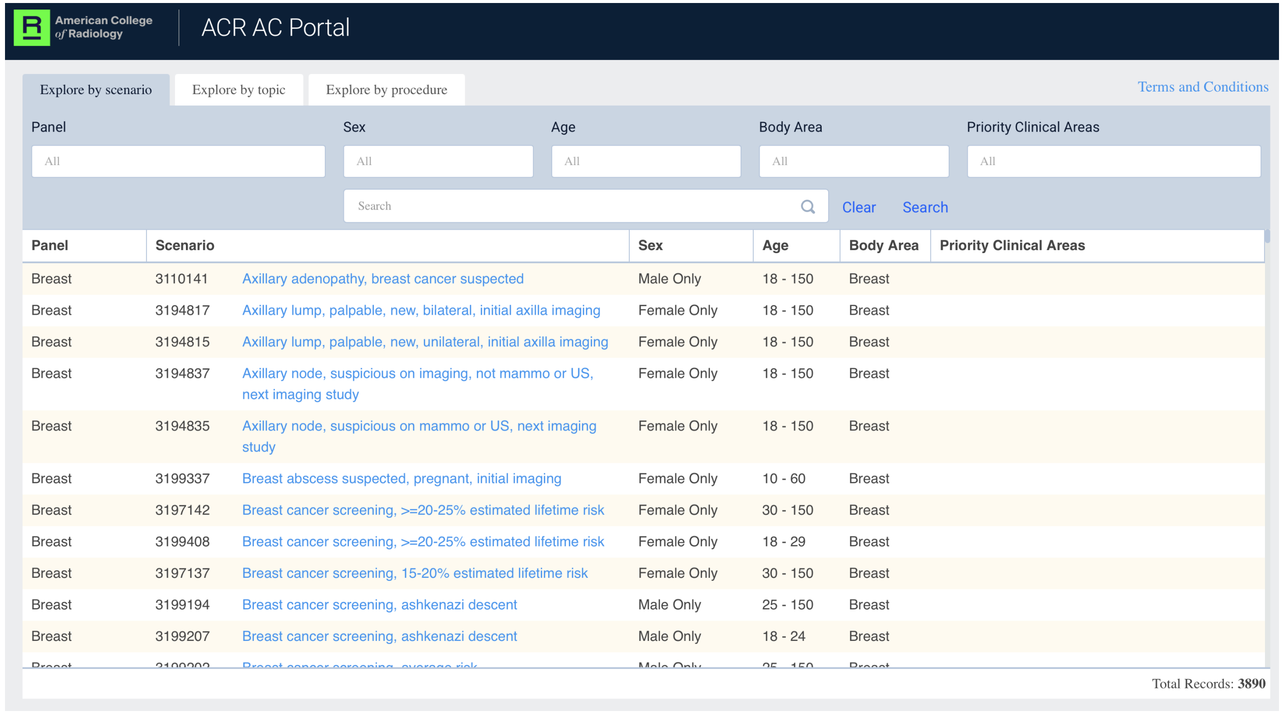



Shreve LA, Fried JG, Liu F, et al. *J Am Coll Radiol*. 2023;20



American College of Radiology | ACR AC Portal

Explore by scenario | Explore by topic | Explore by procedure | Terms and Conditions

Panel: All | Sex: All | Age: All | Body Area: All | Priority Clinical Areas: All

Search | Clear | Search

| Panel | | Scenario | Sex | Age | Body Area | Priority Clinical Areas |
|---|---|---|---|---|---|---|
| Breast | 3110141 | Axillary adenopathy, breast cancer suspected | Male Only | 18 - 150 | Breast | |
| Breast | 3194817 | Axillary lump, palpable, new, bilateral, initial axilla imaging | Female Only | 18 - 150 | Breast | |
| Breast | 3194815 | Axillary lump, palpable, new, unilateral, initial axilla imaging | Female Only | 18 - 150 | Breast | |
| Breast | 3194837 | Axillary node, suspicious on imaging, not mammo or US, next imaging study | Female Only | 18 - 150 | Breast | |
| Breast | 3194835 | Axillary node, suspicious on mammo or US, next imaging study | Female Only | 18 - 150 | Breast | |
| Breast | 3199337 | Breast abscess suspected, pregnant, initial imaging | Female Only | 10 - 60 | Breast | |
| Breast | 3197142 | Breast cancer screening, >=20-25% estimated lifetime risk | Female Only | 30 - 150 | Breast | |
| Breast | 3199408 | Breast cancer screening, >=20-25% estimated lifetime risk | Female Only | 18 - 29 | Breast | |
| Breast | 3197137 | Breast cancer screening, 15-20% estimated lifetime risk | Female Only | 30 - 150 | Breast | |
| Breast | 3199194 | Breast cancer screening, ashkenazi descent | Male Only | 25 - 150 | Breast | |
| Breast | 3199207 | Breast cancer screening, ashkenazi descent | Male Only | 18 - 24 | Breast | |

Total Records: 3890

ACR Appropriateness Criteria® Brain Tumors. Variants 1 to 6 and Table 1 and 2.

| Variant 1. Adult. Primary brain tumor screening. Genetic risk factors. | | |
|---|---|---|
| **Procedure** | **Appropriateness Category** | **Relative Radiation Level** |
| MRI head without and with IV contrast | Usually Appropriate | O |
| MRI complete spine without and with IV contrast | May Be Appropriate | O |
| MRI head without IV contrast | May Be Appropriate | O |
| MR spectroscopy head without IV contrast | Usually Not Appropriate | O |
| MRI complete spine with IV contrast | Usually Not Appropriate | O |
| MRI complete spine without IV contrast | Usually Not Appropriate | O |
| MRI functional (fMRI) head without IV contrast | Usually Not Appropriate | O |
| MRI head perfusion with IV contrast | Usually Not Appropriate | O |
| MRI head perfusion without IV contrast | Usually Not Appropriate | O |
| MRI head with IV contrast | Usually Not Appropriate | O |
| MRI head without IV contrast with DTI | Usually Not Appropriate | O |
| CT head with IV contrast | Usually Not Appropriate | ☢☢☢ |
| CT head without and with IV contrast | Usually Not Appropriate | ☢☢☢ |
| CT head without IV contrast | Usually Not Appropriate | ☢☢☢ |
| DOTATATE PET/CT brain | Usually Not Appropriate | ☢☢☢ |
| DOTATATE PET/MRI brain | Usually Not Appropriate | ☢☢☢ |
| FDG-PET/CT brain | Usually Not Appropriate | ☢☢☢ |
| FDG-PET/MRI brain | Usually Not Appropriate | ☢☢☢ |
| Fluciclovine PET/MRI brain | Usually Not Appropriate | ☢☢☢ |
| Fluciclovine PET/CT brain | Usually Not Appropriate | ☢☢☢☢ |

ACR Appropriateness Criteria® Brain Tumors. Variants 1 to 6 and Table 1 and 2.

**Variant 1.** Adult. Primary brain tumor screening. Genetic risk factors.

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| MRI head without IV contrast with DTI | Usually Not Appropriate | O |
| CT head with IV contrast | Usually Not Appropriate | ☢☢☢ |
| CT head without and with IV contrast | Usually Not Appropriate | ☢☢☢ |
| CT head without IV contrast | Usually Not Appropriate | ☢☢☢ |
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| Fluciclovine PET/MRI brain | Usually Not Appropriate | ☢☢☢ |
| Fluciclovine PET/CT brain | Usually Not Appropriate | ☢☢☢☢ |

Noise reduction

Raw data reconstruction

Synthetic image generation

Personalized scanning protocols

Clinical decision support

Scheduling

Protocoling

Acquisition guidance

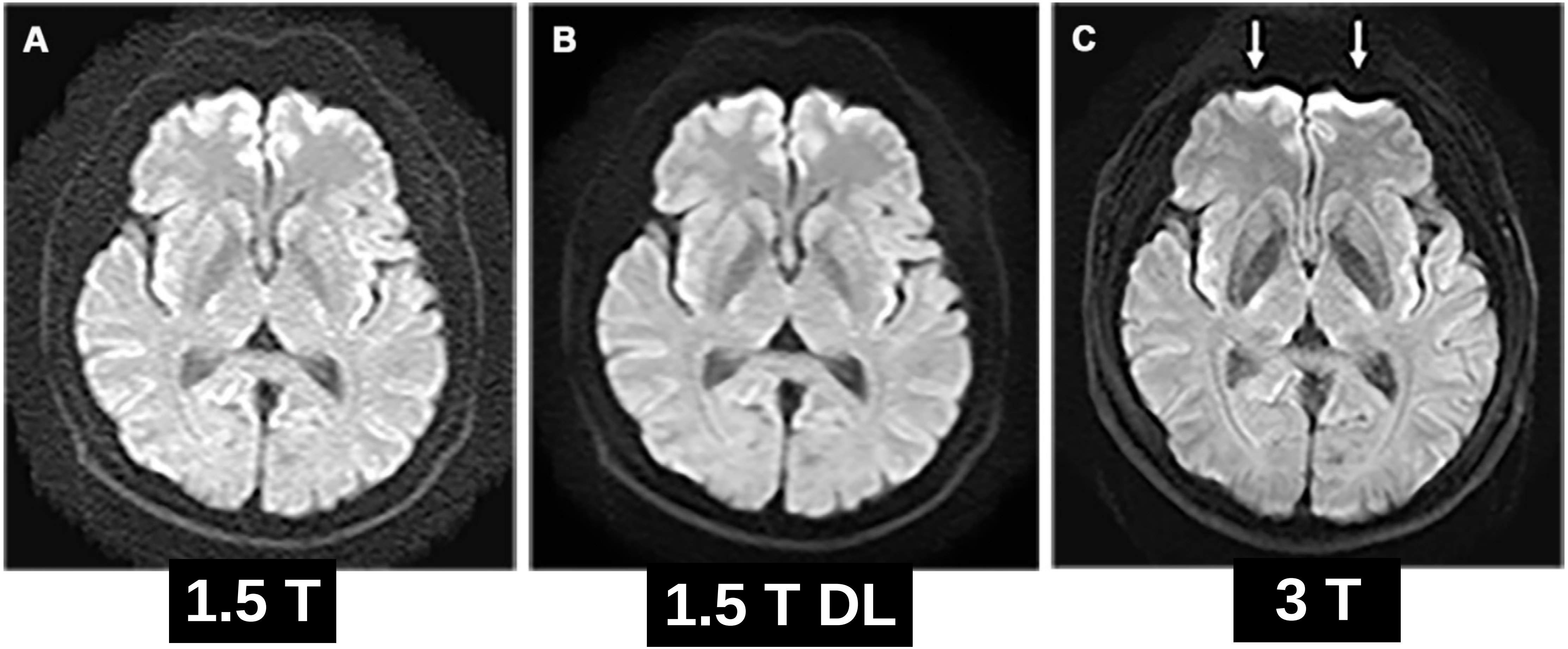
Quality standardization

Image optimization

Post processing

Worklist optimization

# Image Quality: DL Denoising

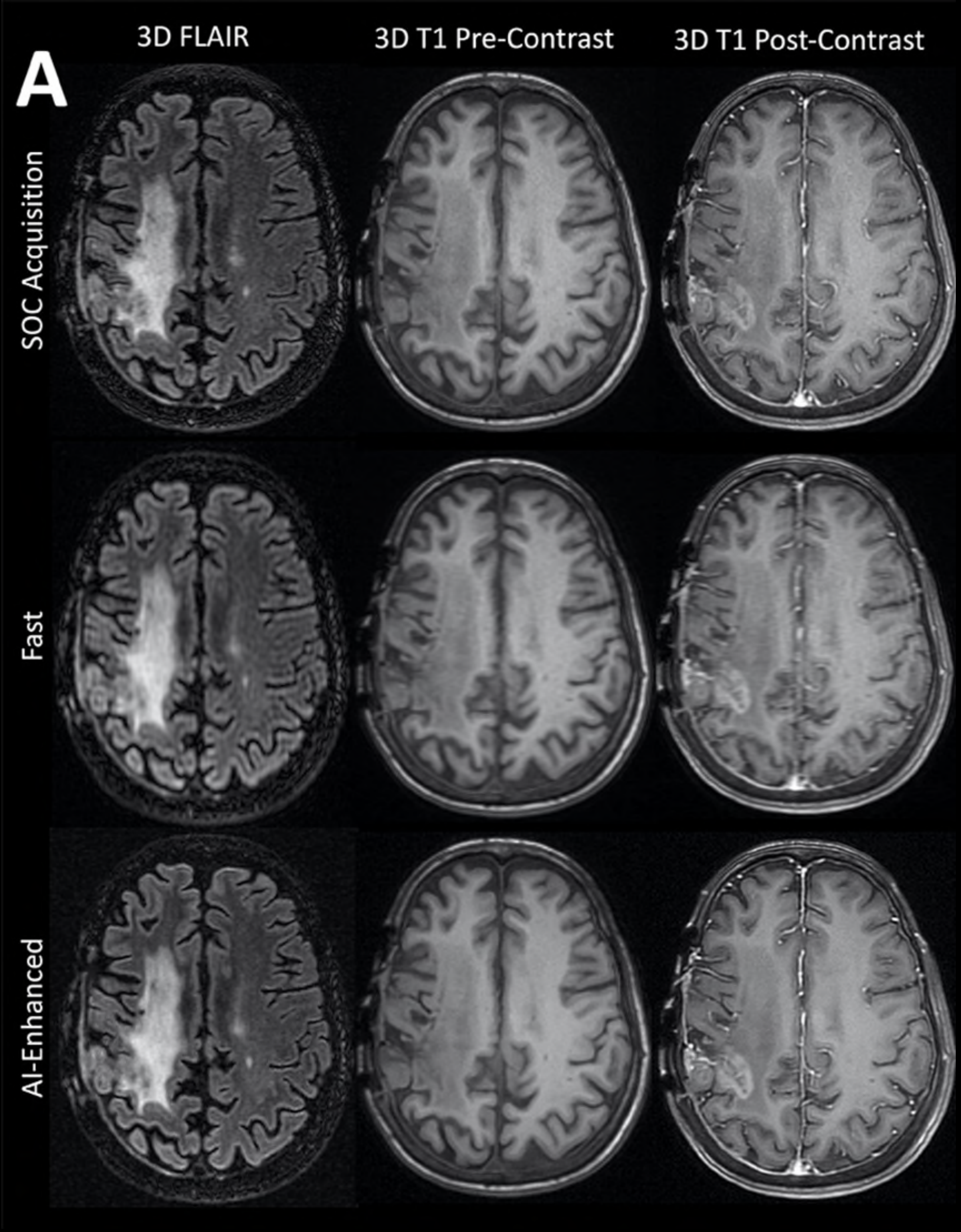



1. Kiryu S, Akai H, Yasaka K, et al. Clinical Impact of Deep Learning Reconstruction in MRI. *RadioGraphics*. 2023;43(6):e220133. doi:10.1148/rg.220133

# Image Quality: DL Acceleration

| | Sequence | | | | | |
|---|---|---|---|---|---|---|
| | 3D T1 Precontrast | | 3D T2 FLAIR | | 3D T1 Postcontrast | |
| Imaging Parameter | SOC | Faster | SOC | Faster | SOC | Faster |
| Acquisition plane | Axial | Axial | Sagittal | Sagittal | Axial | Axial |
| TR (msec) | 8 | 8 | 5500 | 5500 | 8 | 8 |
| TE (msec) | 3 | 3 | 160 | 160 | 3 | 3 |
| Flip angle (degrees) | 15 | 15 | 90 | 90 | 15 | 15 |
| Section thickness (mm) | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| Acquisition matrix | 256 × 256 | 256 × 128 | 256 × 256 | 256 × 128 | 256 × 256 | 256 × 128 |
| Acquisition time (sec) | 175 | 96 | 344 | 190 | 175 | 96 |
| Time reduction (%) | | 45.1 | | 44.7 | | 45.1 |

Rudie JD, Gleason T, Barkovich MJ, et al. Clinical Assessment of Deep Learning–based Super-Resolution for 3D Volumetric Brain MRI. *Radiol: Artif Intell*. 2022;4(2):e210059.




Rudie JD, et al *Radiol: Artif Intell*. 2022

Noise reduction

Raw data reconstruction

Synthetic image generation

Personalized scanning protocols

Clinical decision support

Scheduling

Protocoling

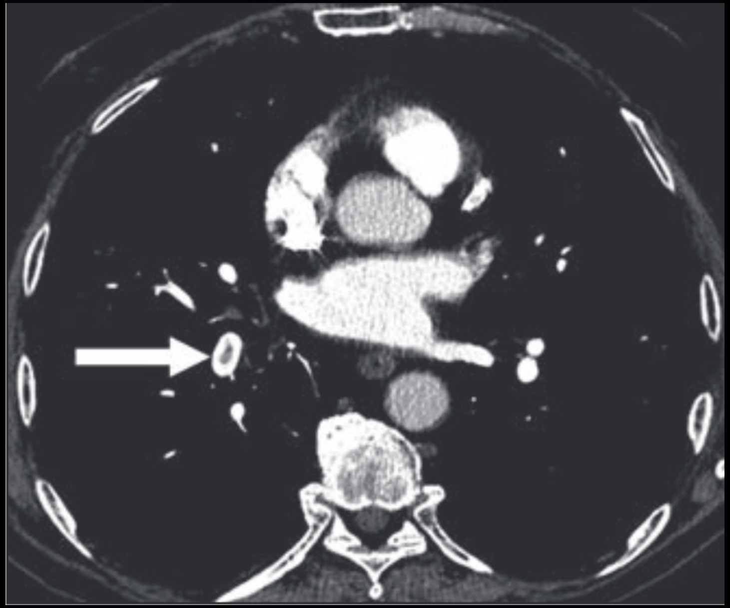
Acquisition guidance

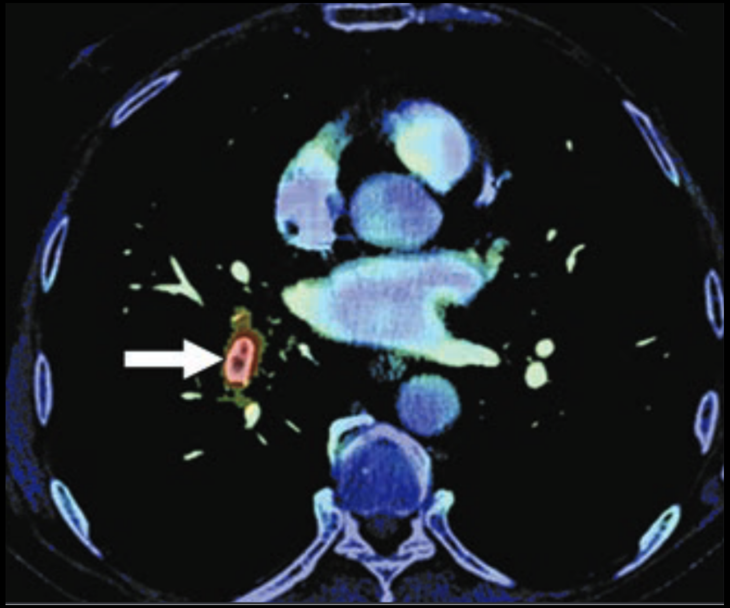
Quality standardization

Image optimization

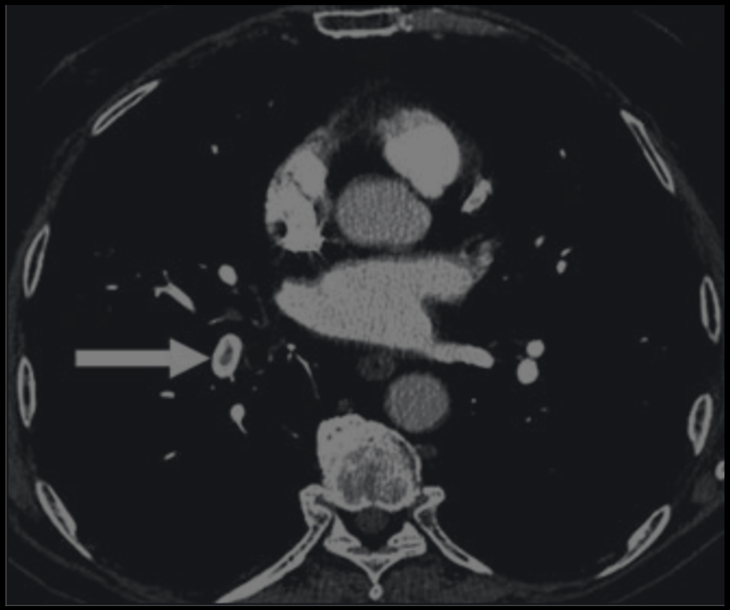
Post processing

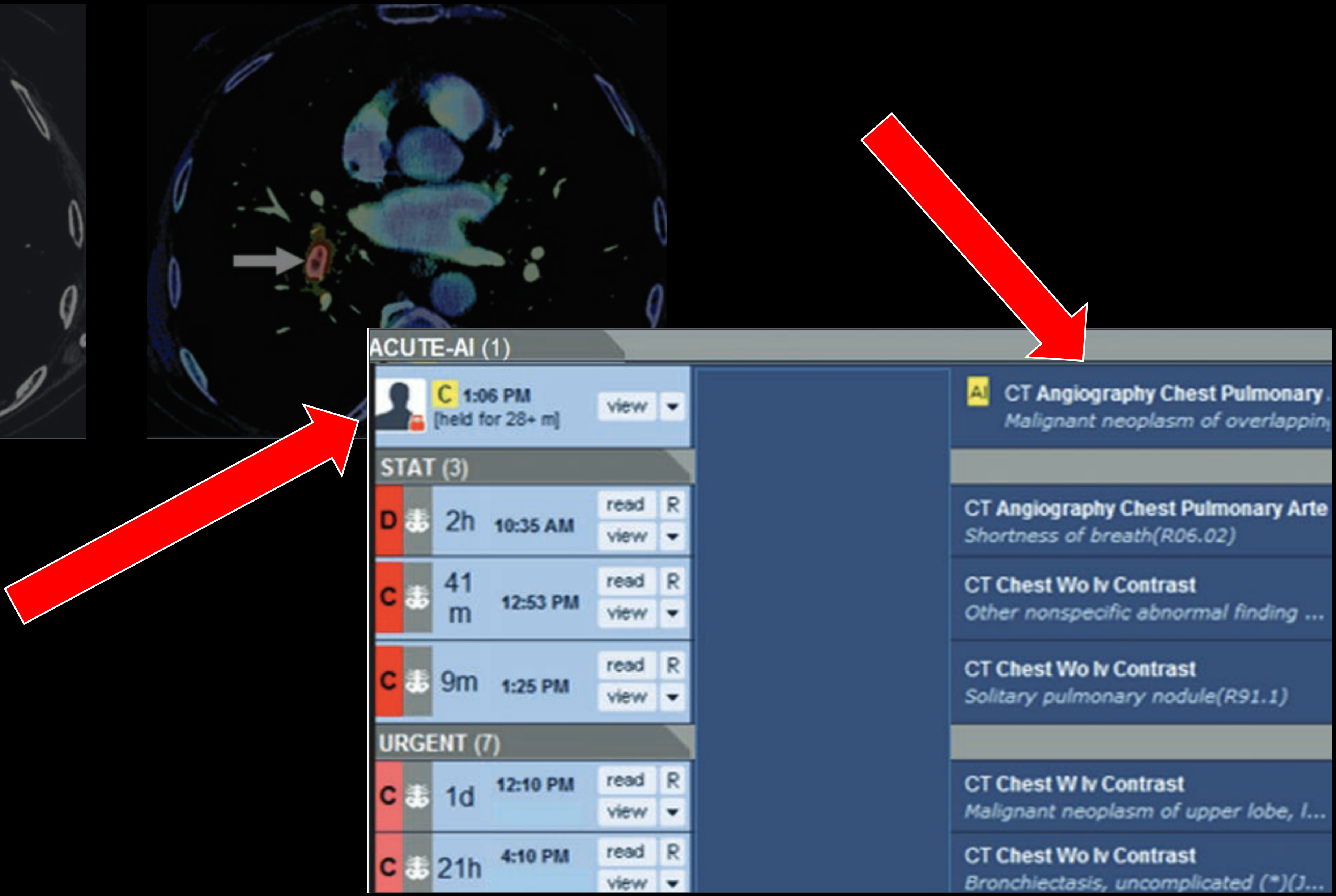
**Worklist optimization**





1. Batra K, et al. *Am J Roentgenol*. 2023;221(3):324-333.





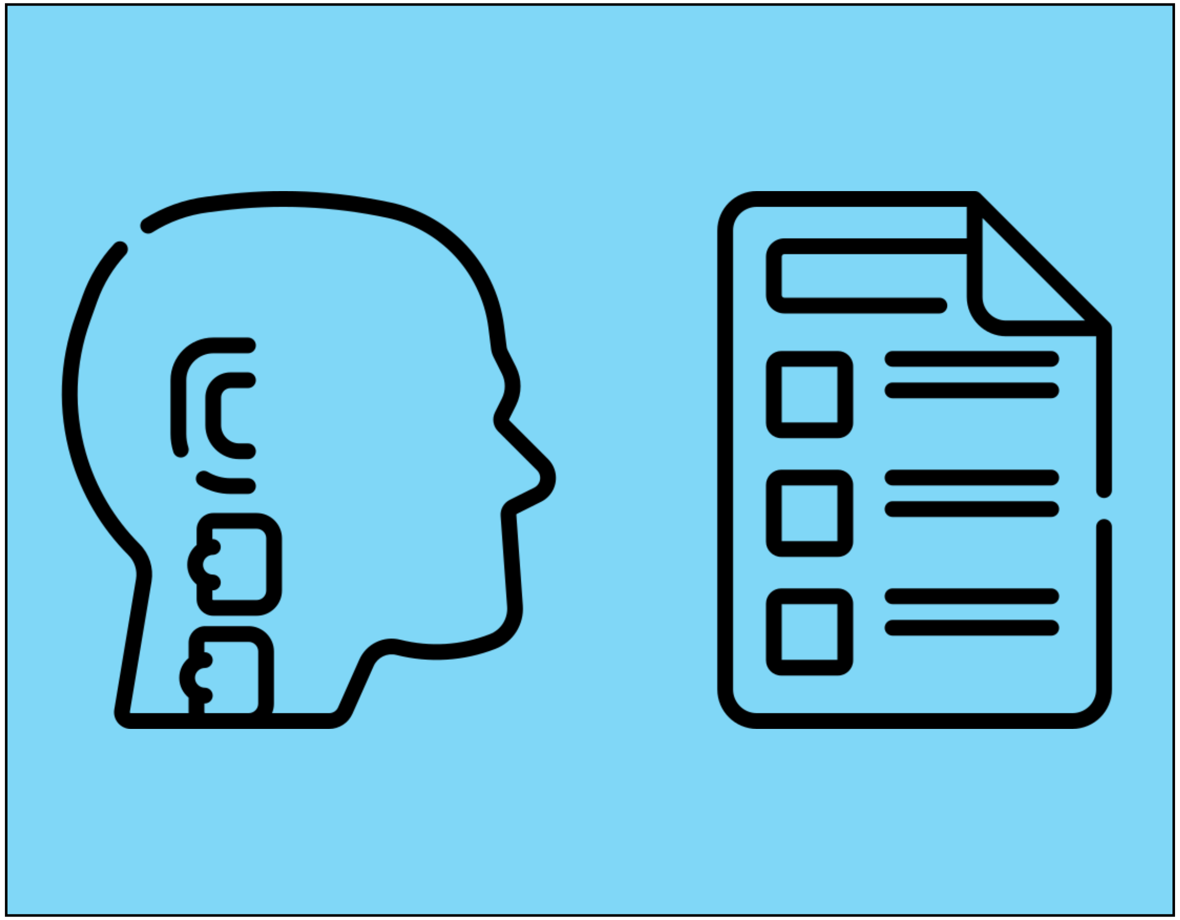

1. Batra K, et al. *Am J Roentgenol*. 2023;221(3):324-333.

Segmentation

Treatment planning

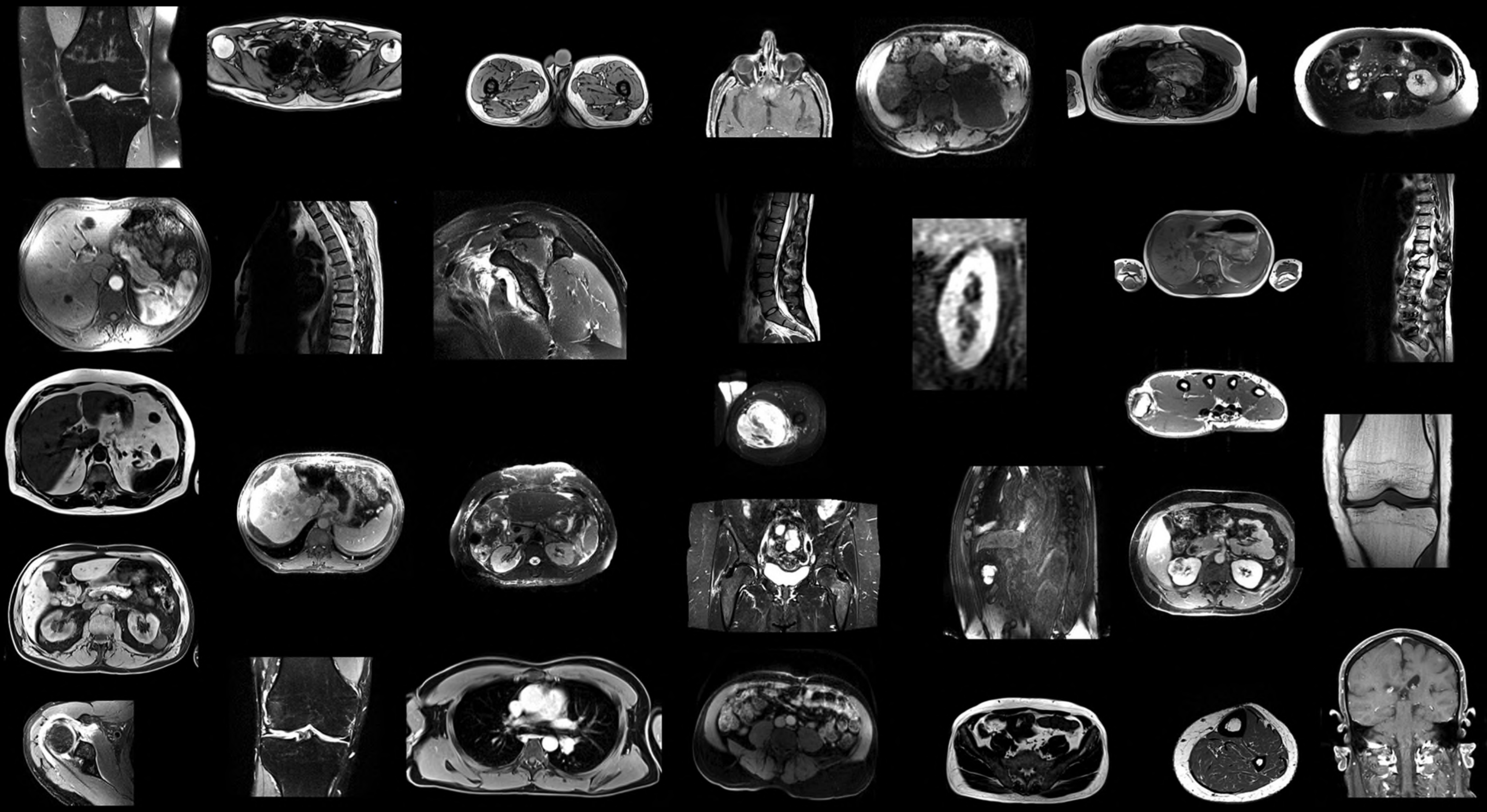
Radiomics

Natural language processing

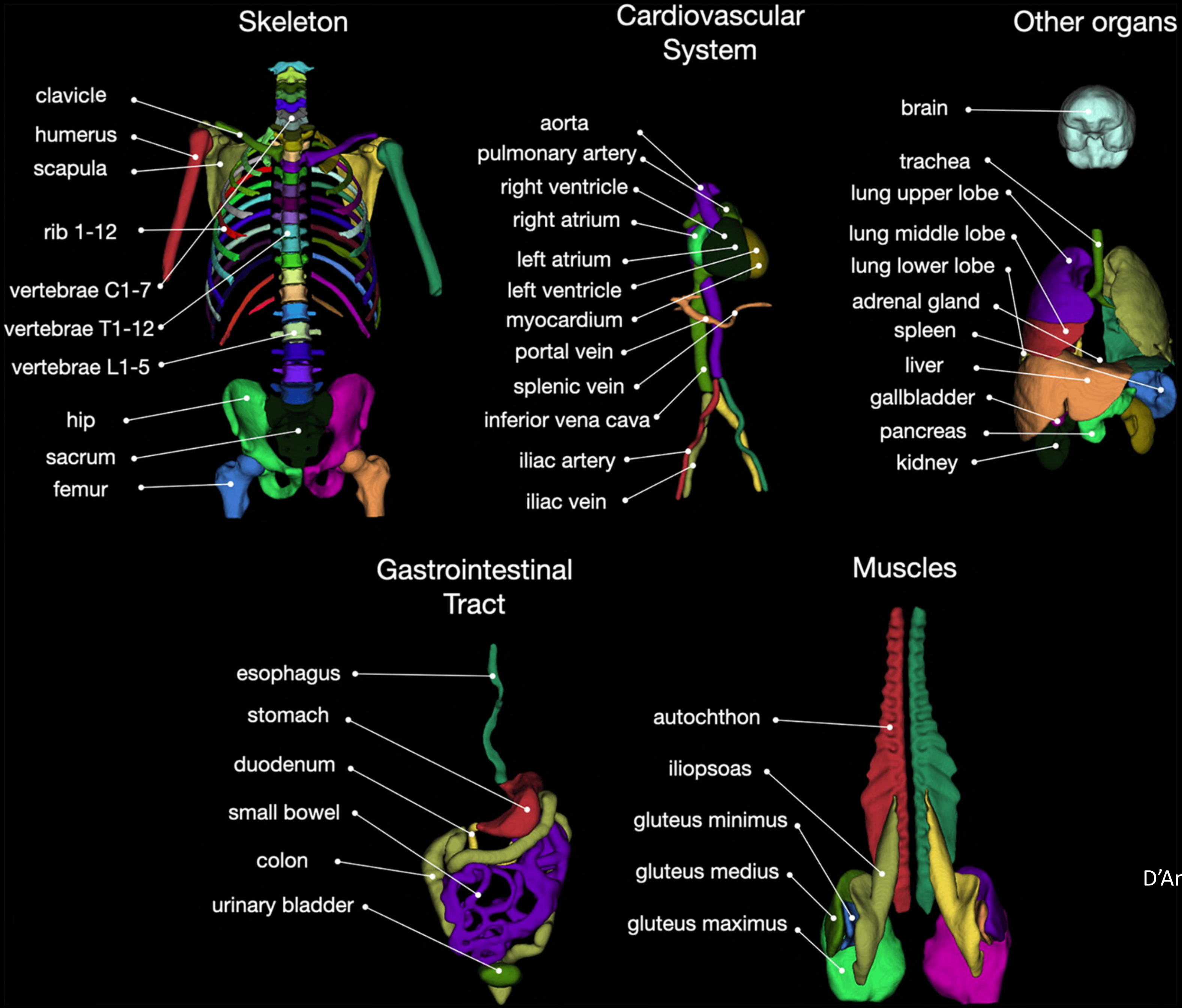


## *Downstream Processes*

# Downstream Processes - Segmentation



D’Antonoli TA, et al. *Radiology*. 2025.



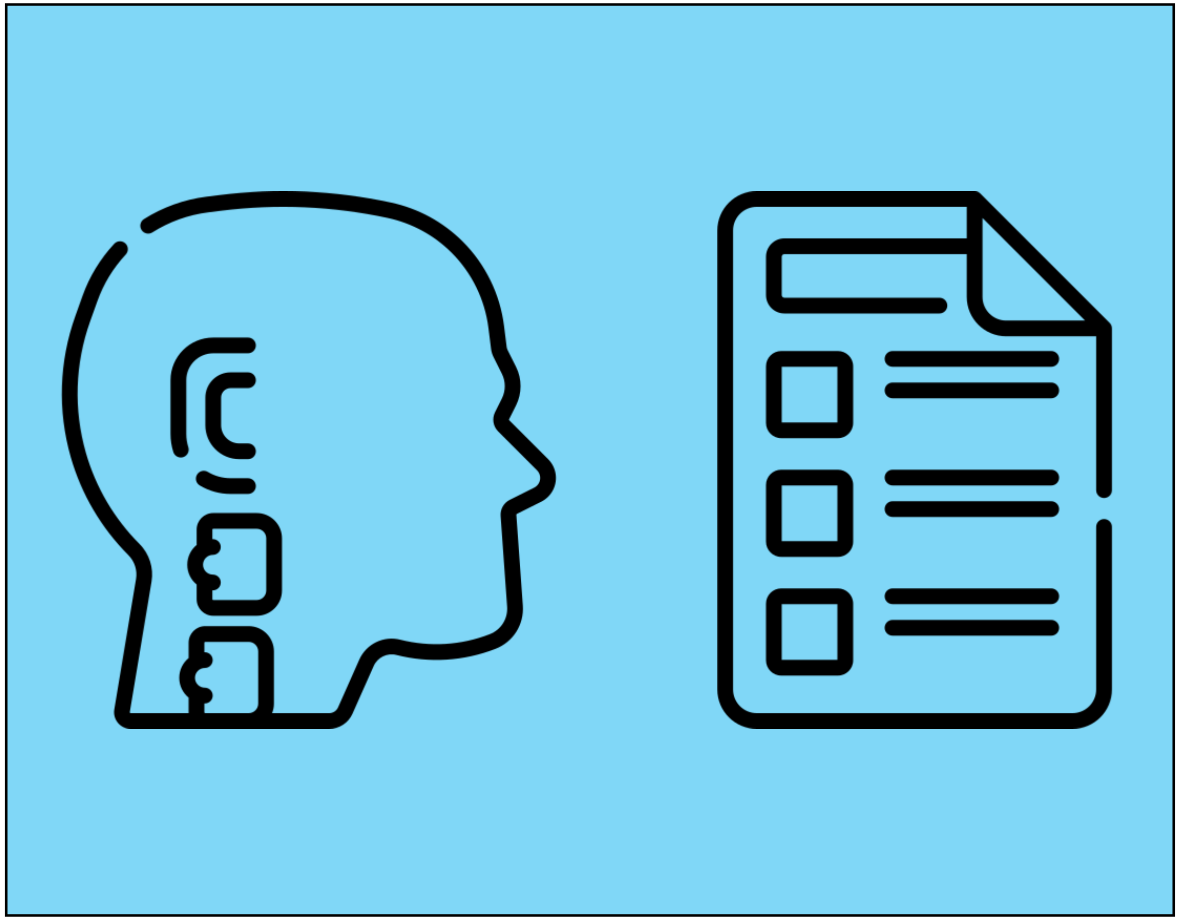

D'Antonoli TA, et al. *Radiology*. 2025.

Segmentation

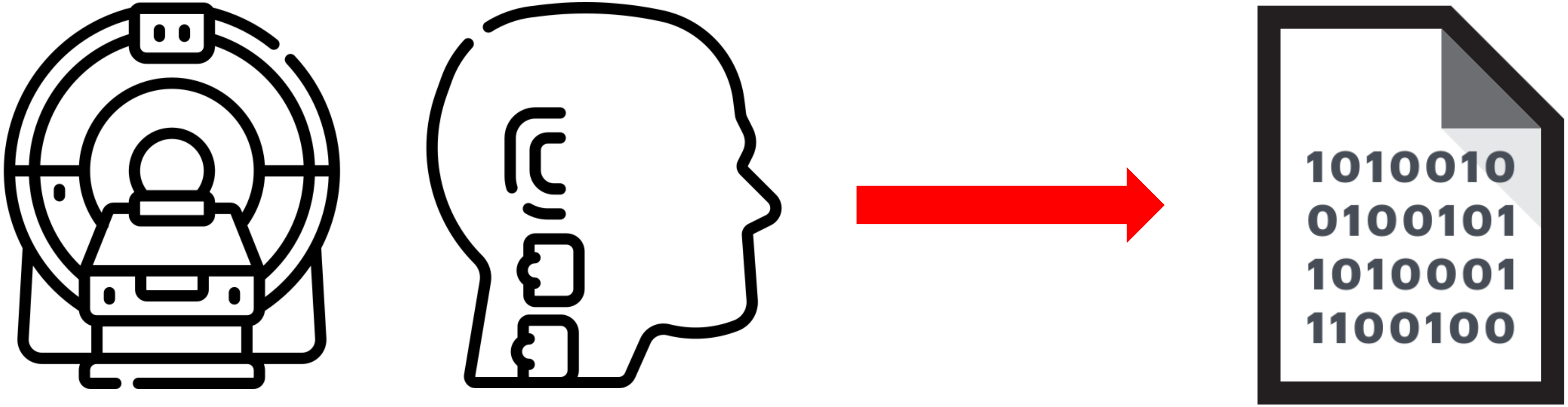
Treatment planning

Radiomics

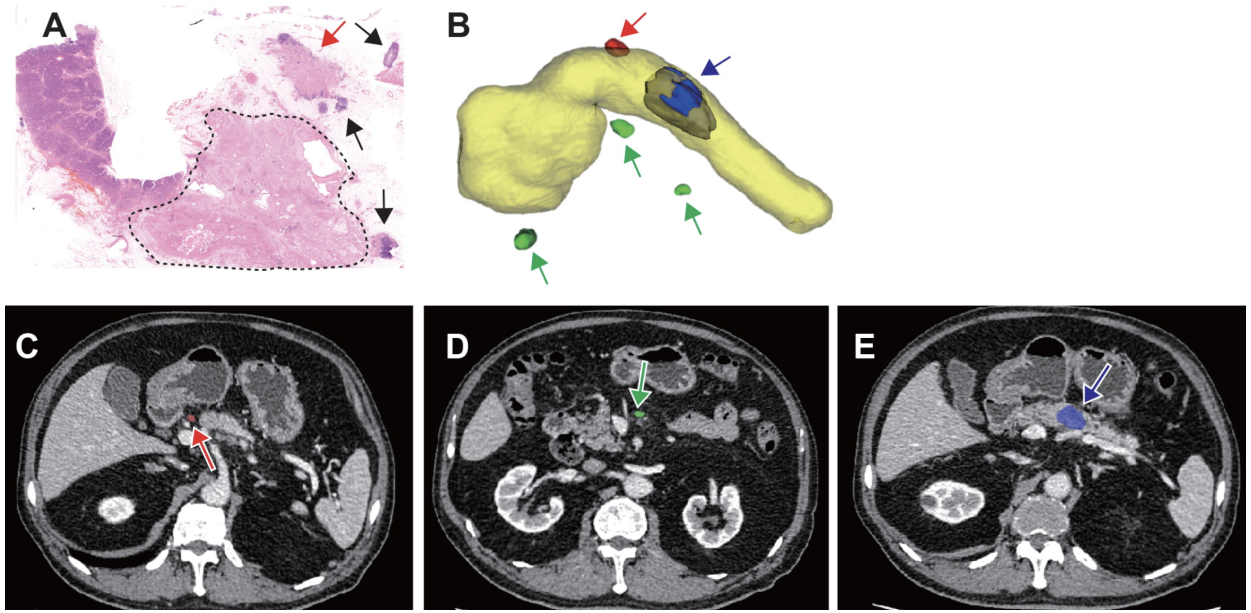
Natural language processing



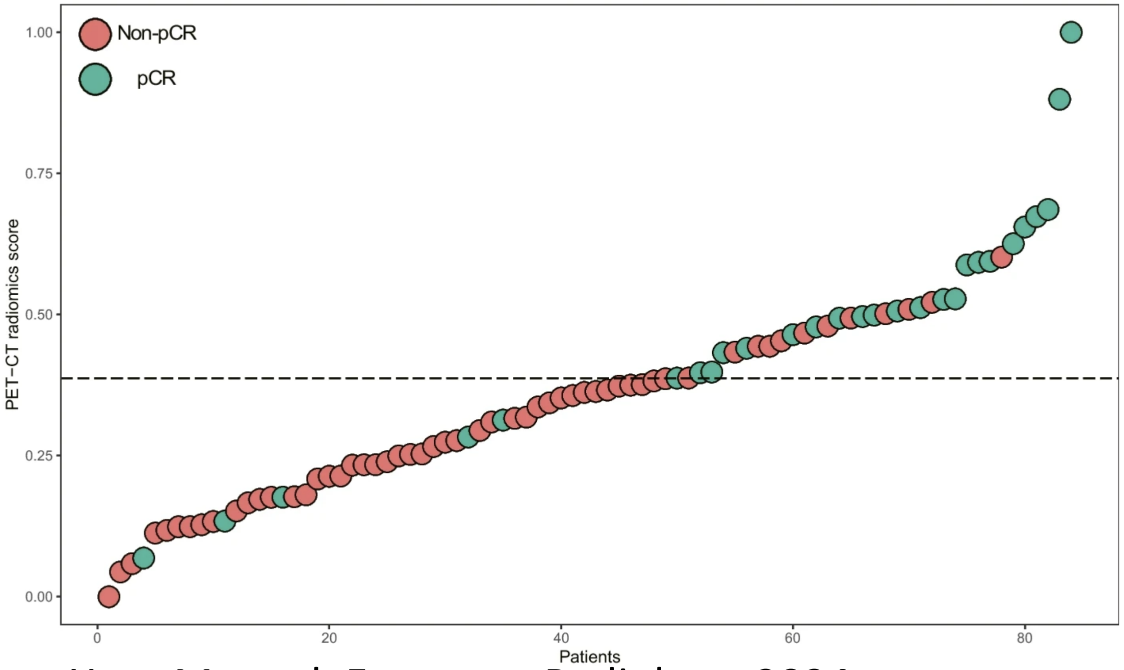
**_Downstream Processes_**




# Radiomics




Bian Y, et al. *Radiology*. 2023.




Yang M, et al. European Radiology. 2024.

## Diagnosis & classification

## Treatment prediction

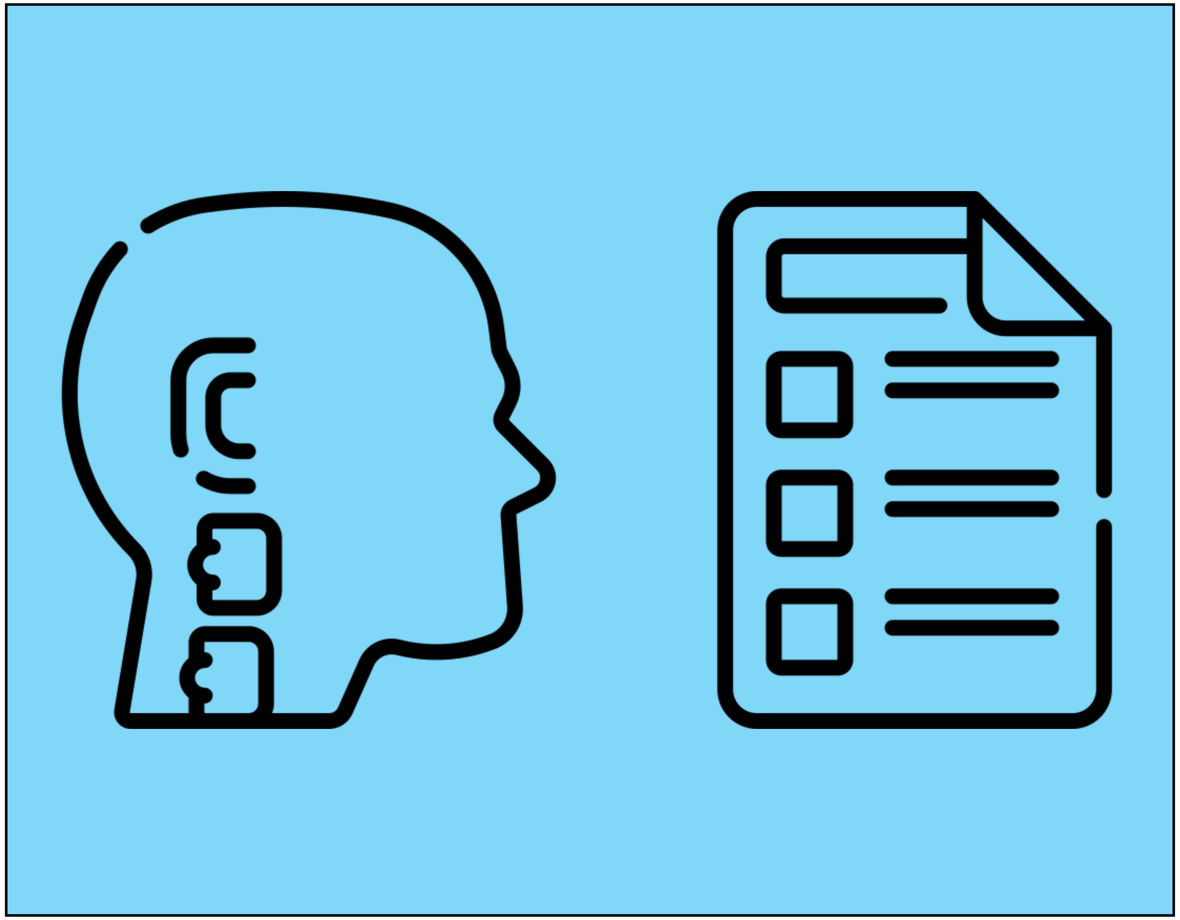
# *Radiomics*

Segmentation

Treatment planning

Radiomics

Natural language processing

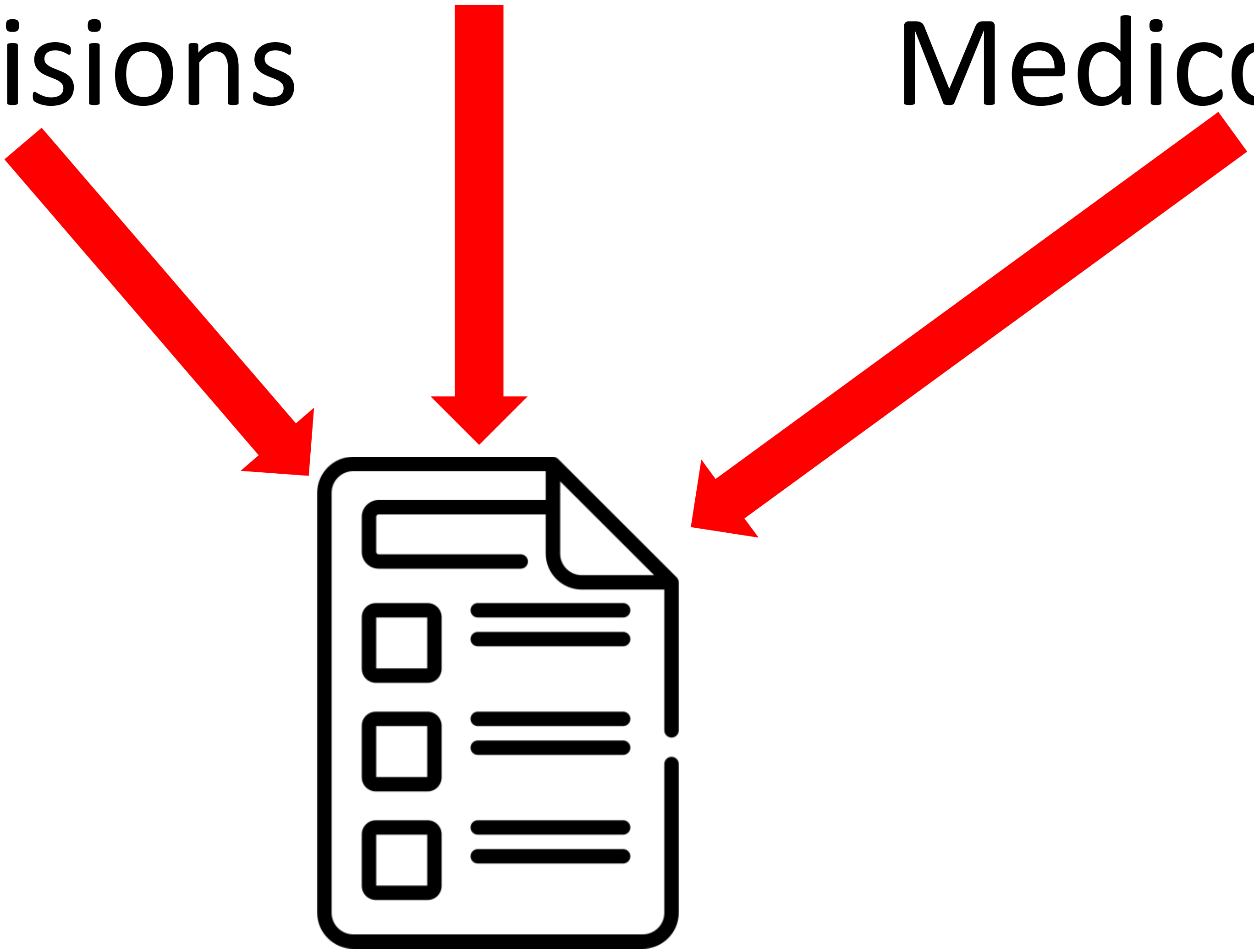


***Downstream Processes***

$$$

Clinical Decisions

Medicolegal



FINDINGS:

NECK:
Parotid glands: The parotid glands are stable in appearance.
Submandibular glands: The submandibular glands are stable in appearance.
Thyroid gland: The thyroid gland is stable in appearance and heterogeneous in attenuation with suggestion of heterogeneou nodules, such as the approximately 6 mm heterogeneous nodule within the right thyroid lobe on series 11, image 96. The thyroid gland would be better evaluated with ultrasound.
Oral cavity: Evaluation of the oral cavity is limited due to streak artifact from dental amalgam.
Pharynx/larynx: There is persistent asymmetric soft tissue fullness within the right greater than left oropharynx (including th right
There are right tonsilloliths.
Lymph nodes: No significant change in the prominent bilateral cervical and supraclavicular lymph nodes, such as the left lev 2 lymph node measuring approximately 14 mm x 9 mm on series 11, image 60.
Paranasal sinuses: Scattered paranasal sinus mucosal thickening. Polypoid densities within the right maxillary sinus.
Mastoid air cells: Visualized mastoid air cells are clear. Soft tissue attenuating material within the bilateral external auditory canals, which is non-specific but may potentially represent cerumen.
Nasal cavity: Polypoid mucosal thickening within the bilateral nasal cavity. Narrowing of the bi
Vessels: The left vertebral artery is asymmetrically smaller than the right vertebral artery, not significantly changed.
Globes are intact. Persistent features suggestive of bilateral enophthalmos. Suggestion of mild thickening within the bilateral periorbital regions, which is nonspecific.

# Extraction of data labels

# Patient friendly translations

CHEST:
Axilla: No significant change in the prominent axillary lymph nodes with preservation of a fatty hilum.
Mediastinum/hilum/heart: No significant change in the ill-defined soft tissue density within the anterior mediastinum, which is nonspecific but may potentially represent thymic tissue. No significant change in the scattered prominent mediastinal lymph nodes, such as the precarinal lymph node measuring approximately 13 mm x 5 mm on series 4, image 61. No significant change in the prominent hilar lymph nodes, such as the approximately 9 mm x 5 mm right hilar lymph node on series 4, image 71. Heart size is stable and mildly enlarged. Small pericardial effusion. Small hiatal hernia.
Features suggestive of esophageal wall thickening, which is nonspecific. Cardiophrenic lymph nodes measure subcentimeter in short axis, not significant by CT size criteria.
Lungs: Scarring within the bilateral lung apices. Mild bilateral peribronchial thickening. Atelectasis within the bilateral lower lungs. There are ill-defined groundglass densities and septal thickening within the bilateral lower lungs, which are nonspecific. Possible trace bilateral pleural effusions.
There is bilateral posterior pleural nodularity, which is nonspecific. There are scattered subcen
significantly changed.

# Smart recommendations

ABDOMEN/PELVIS:
Liver: The liver is mildly enlarged measuring approximately 16.2 cm in SI dimension. No signific
hypoattenuation within the liver adjacent to the intersegmental fissure on series 4, image 166
Spleen: The spleen is at the upper limits of normal in size measuring approximately 9.4 cm in S dimension.
Gallbladder and Biliary Tree: Suggestion of mild gallbladder wall thickening, which is nonspecif
Pancreas: The pancreas is stable in appearance. Persistent prominence of the main pancreatic
Adrenal Glands: Stable nodular thickening of the adrenal glands.
Kidneys: The kidneys enhance symmetrically. There is no hydronephrosis. Low-density lesions
Vasculature: There is heterogeneity within the portal vein, which is nonspecific but may be rel ed to contrast mixing artifact.
Bladder: The urinary bladder is distended. There is mild circumferential bladder wall thickening which is nonspecific.
Pelvic Organs: Persistent heterogeneous appearance of the uterus.
Bowel and Peritoneum: There is no evidence of bowel obstruction. Suggestion mild wall thicke
stranding within the peritoneal and mesenteric fat or in the nodular thickening along the perit
Abdominal and Pelvic Lymphadenopathy: Scattered upper abdominal, mesenteric, retroperito eal, inguinal, and pelvic lymph no s that measure subcentimeter in short axis, not significant by CT size criteria.
Abdominal Wall: There are scattered areas of haziness and stranding within the soft tissues of e abdominal and pelvic wall, which are nonspecific.

# Improved critical findings communication

BONES:
No significant change in the bony structures. There is no significant change in scattered lytic a sclerotic bony lesions.
-There is no significant change in the mixed lytic/sclerotic lesion within the right iliac bone wit associated cortical disruption and soft tissue co
-No significant change in the sclerotic lesion measuring approximately 4 mm within the poster r left fourth rib on series 4, image 336.
-No significant change in the heterogeneous sclerotic lesion within the posterior T2 vertebral dy on series 4, image 25 measuring approximately 4 mm.

Degenerative changes within the spine. Mild vertebral height loss at multiple levels within the spine. Incidental note is made of torus mandibularis.

IMPRESSION:
1. Persistent asymmetric soft tissue fullness within the right greater than left oropharynx (including the right greater than left base of tongue extending into vallecula).
is recommended.
2. No significant change in the prominent bilateral cervical and supraclavicular lymph nodes.
3. Scattered subcentimeter lung nodules, stable. These are nonspecific.
4. No significant change in the scattered lytic and sclerotic bony lesions, such as the mixed lytic and sclerotic lesion within the right iliac bone with associated cortical dis uption and soft tissue components.
5. The thyroid gland is heterogeneous in attenuation with suggestion of heterogeneous nodules, such as the approximately 6 mm heterogeneous nodule within the right
6. Mild hepatomegaly. No significant change in the approximately 13 mm hypoattenuating lesion within the right hepatic lobe, which is nonspecific.

# Smart Impression

Clinical decision support

Scheduling

Protocoling

Acquisition guidance

Quality standardization

Image optimization

Post processing

Worklist optimization

***Upstream Processes***

Segmentation

Treatment planning

Radiomics

Natural language processing

***Downstream Processes***

# Foundations and Key Concepts

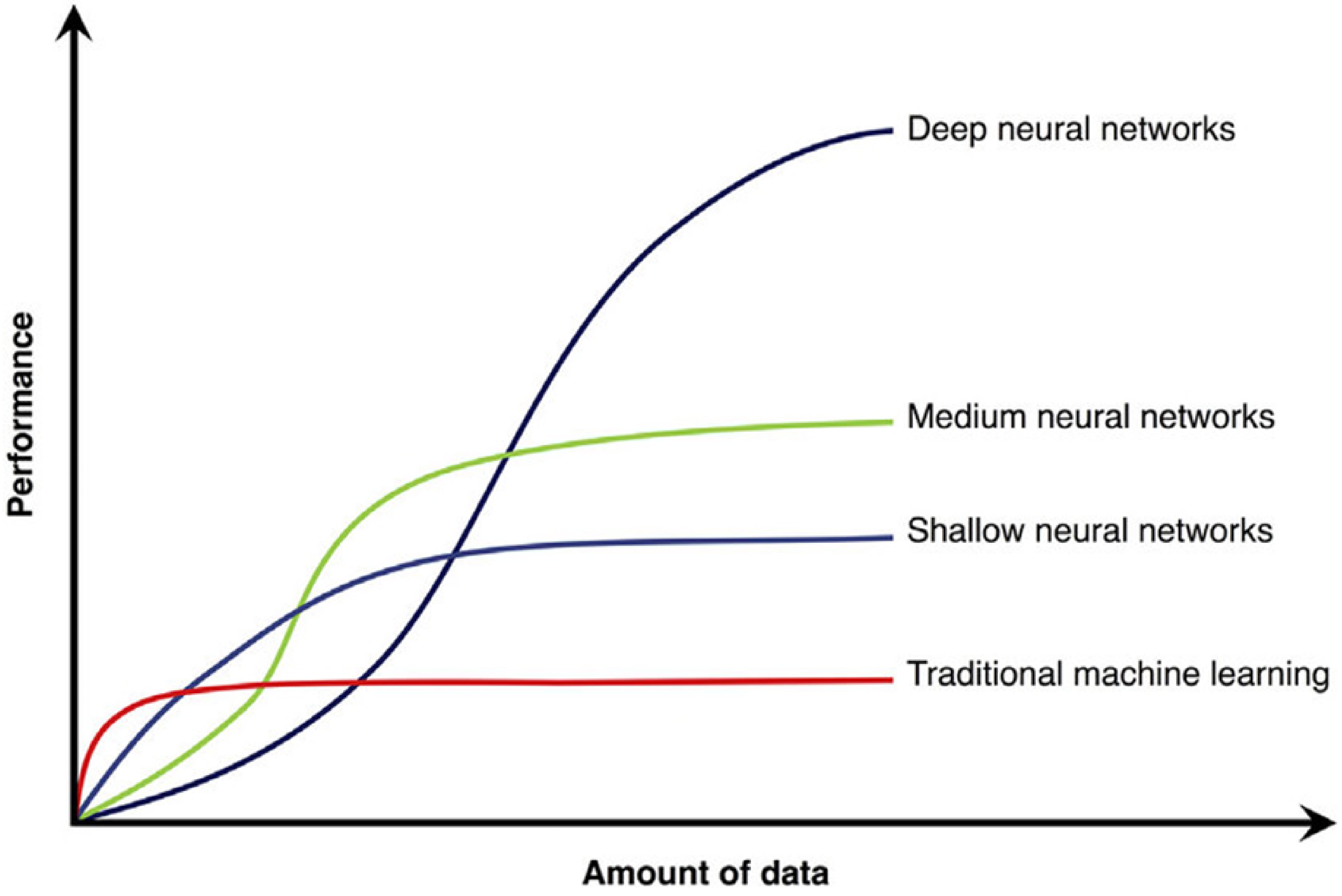
# Past: How did we get here?

# Present: Real world applications

# Limitations and Challenges

# Future: What's coming?


Limitations and Bias
DATA




Tang, An et al. Canadian Association of Radiologists Journal. 2018.

**ImageNet – 14m images, 22k categories**

Radiopaedia

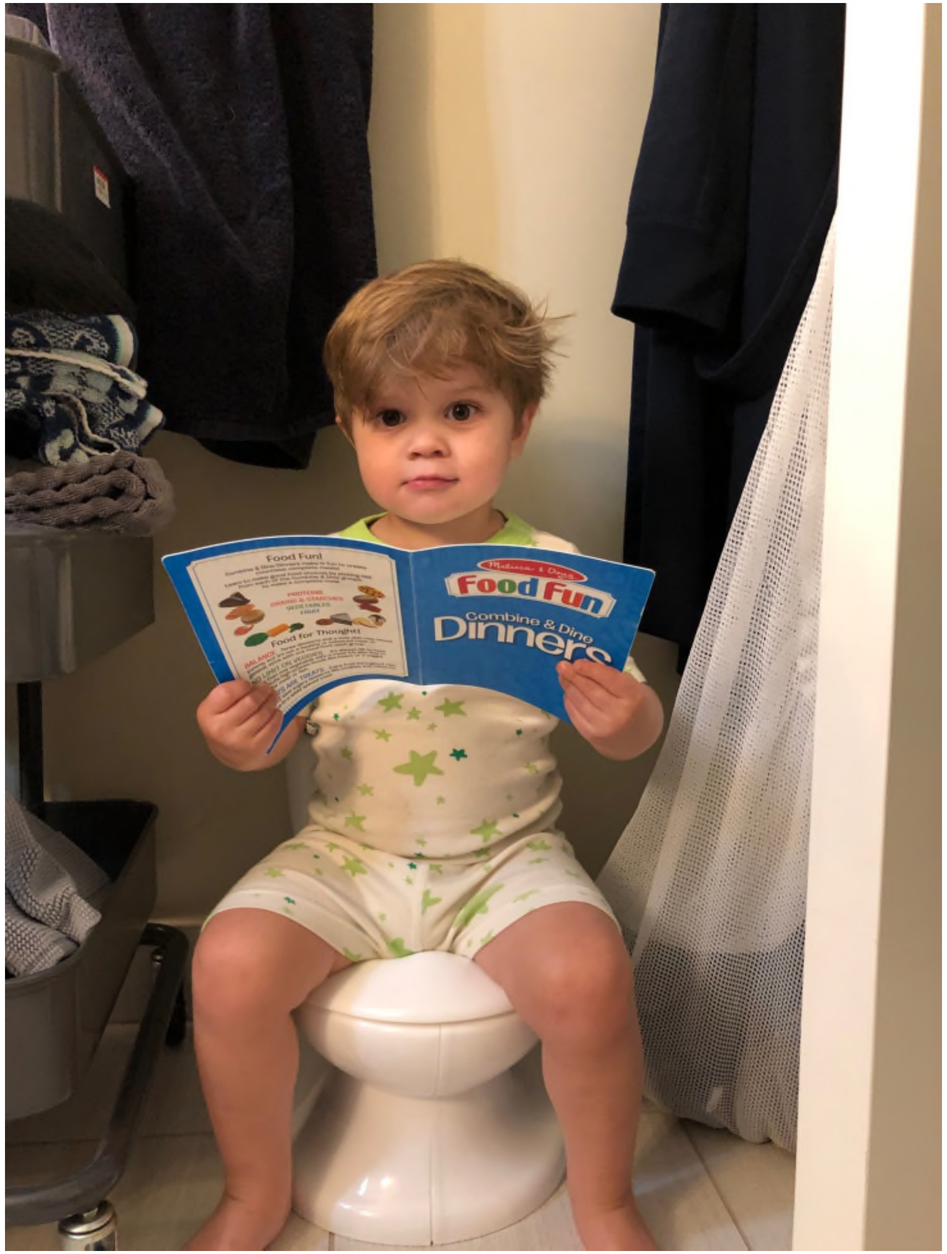
# Imaging data sets (artificial intelligence)

Assoc Prof Frank Gaillard and Andrew Murphy et al.

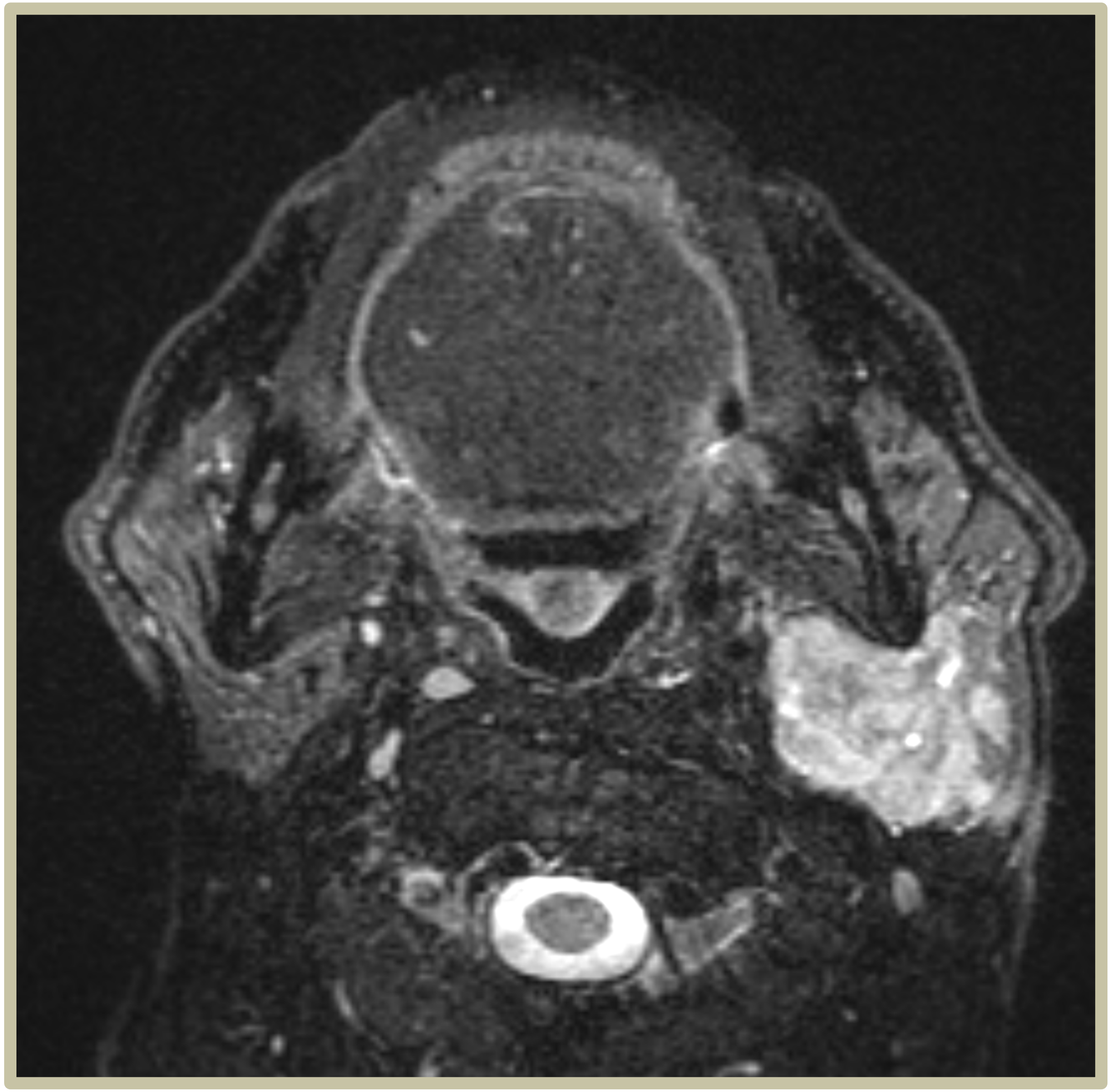
- 1000 Functional Connectomes Project: over 1000 functional MRI exams collected from sites across the globe
- ACR Data Science: list of ~20 data sets
- CheXpert: 224,316 chest radiographs
- Computed Tomography Emphysema Database small images specifically for texture analysis
- Johns Hopkins University Data Archive contains a data set of head CT scans
- The Medical Image Bank of Valencia
- MD.ai: a collection of public projects
- OpenI - The Open Access Biomedical Image Search Engine: data sets search engine, API (application programmer interface) to create customized data sets available at MedPix
- OpenNeuro: list of over 200 neuro data sets
- OASIS: open access neuro data sets
- Spineweb 16 spinal imaging data sets
- UCLH Stroke EIT Dataset
- MRNet: 1,370 annotated knee MRI examinations
- MURA: a large dataset of musculoskeletal radiographs
- MIMIC-CXR Database: 377,110 chest radiographs with free-text radiology reports
- PADCHEST: 160,000 chest X-rays with multiple labels on images
- TB Portals
- UC Irvine Machine Learning Repository: various radiological and nuclear medicine data sets among other types of data sets
- York Cardiac MRI Dataset cardiac MRIs
- Zenodo searchable projects

# *Ground truth?*

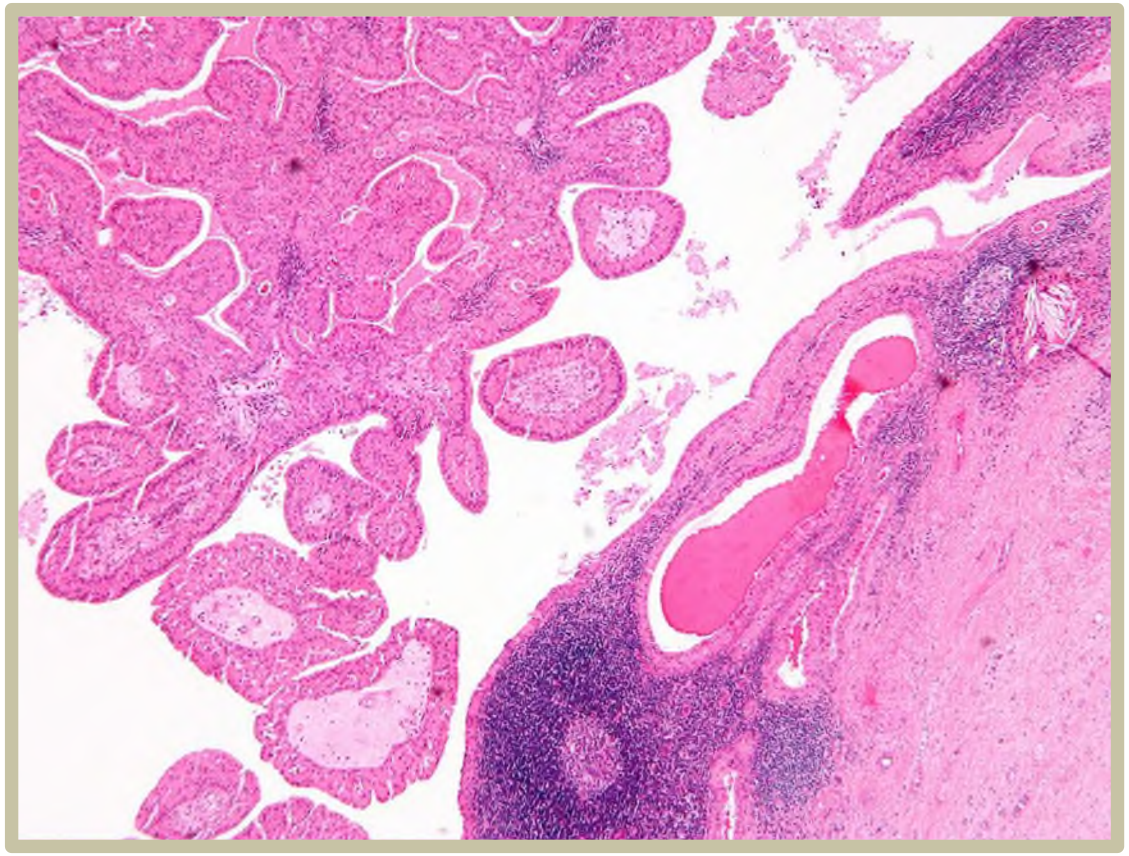
- Cat
- Dog
- Boy
- Truck

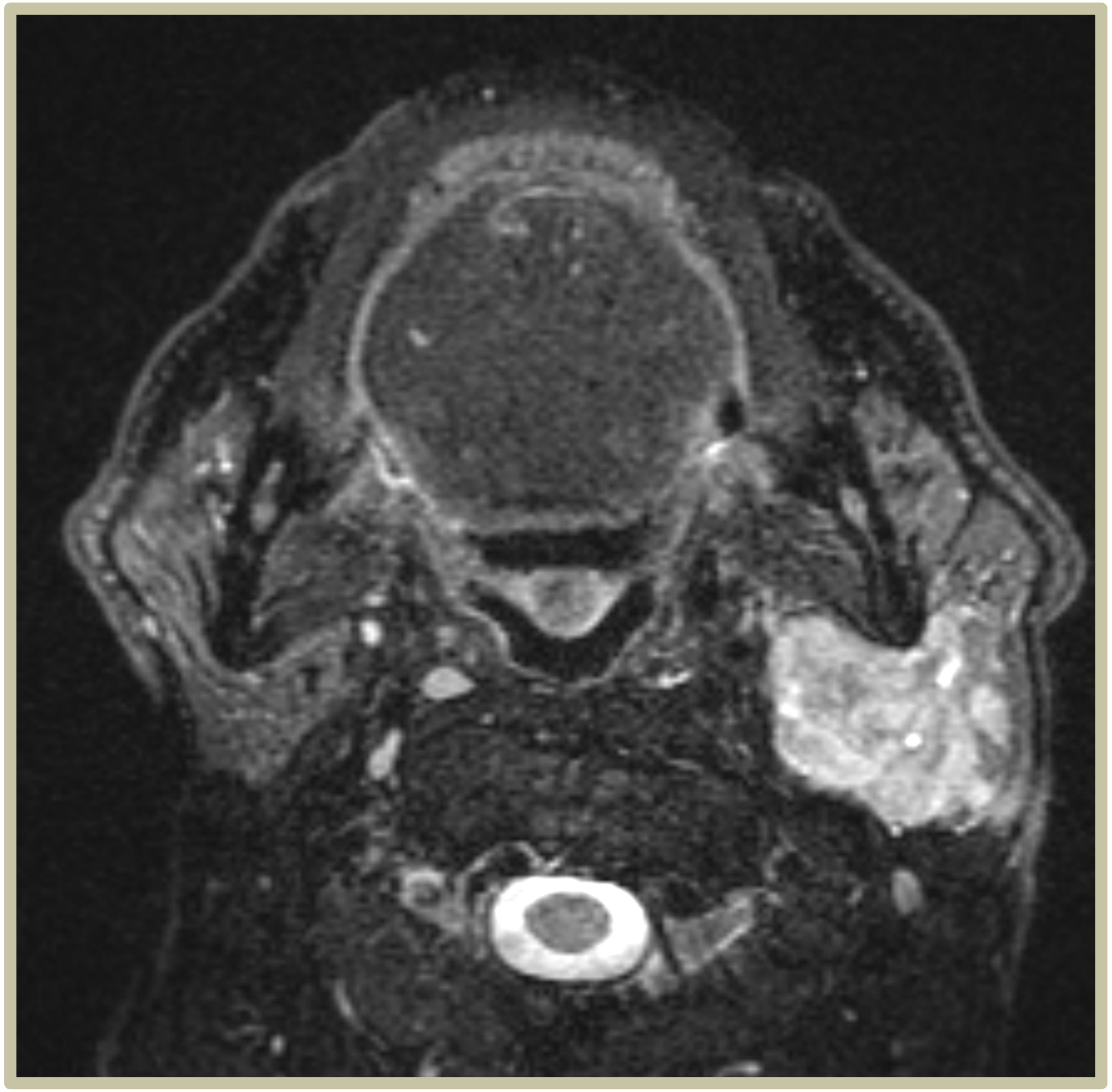


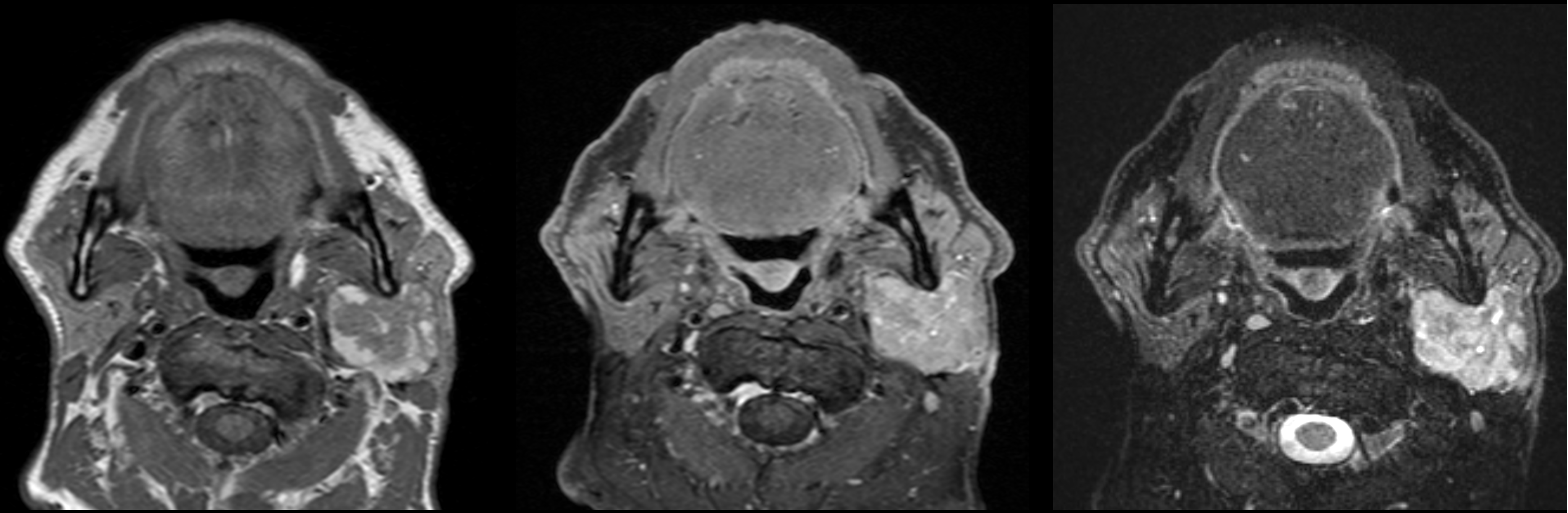
# Ground truth?

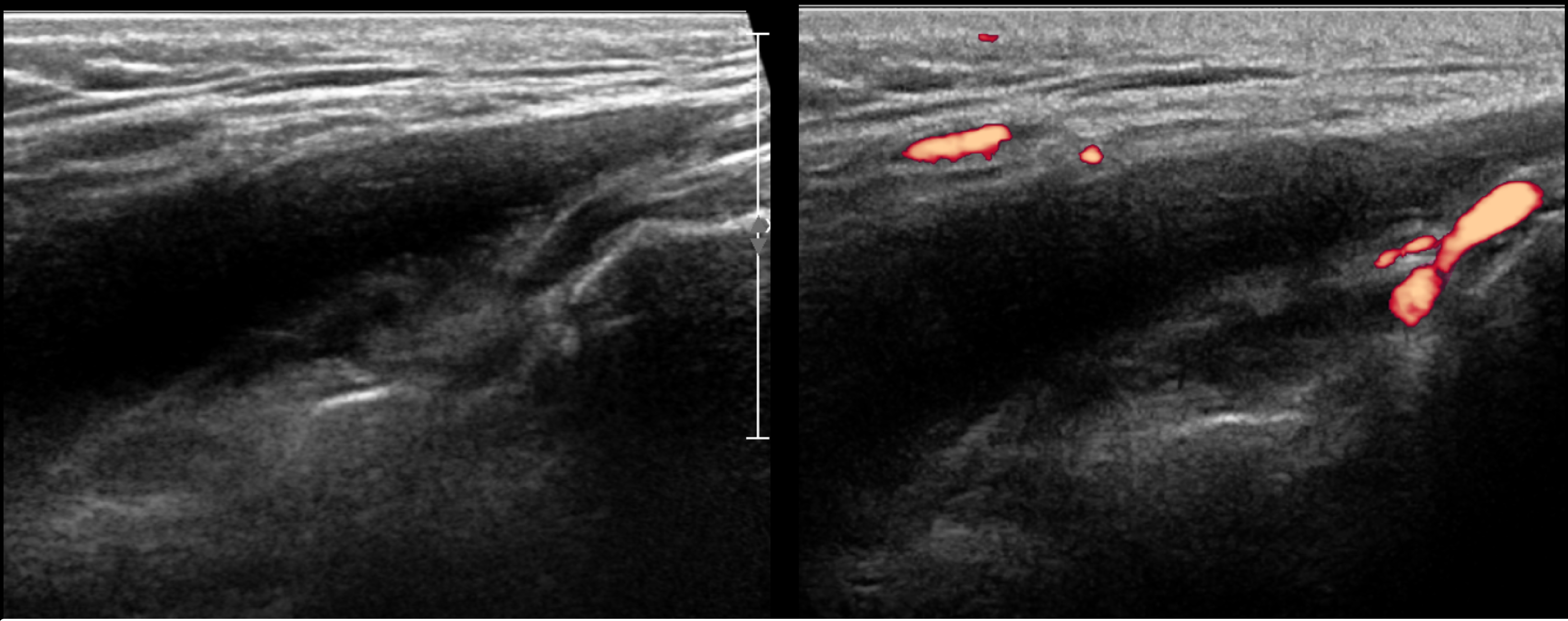


# Ground truth?









Complex, Layered Data


When you hear hoofbeats behind you,
don't expect to see a zebra

BMT

Warthin

Adenoid Cystic

Mucoep

Met LN

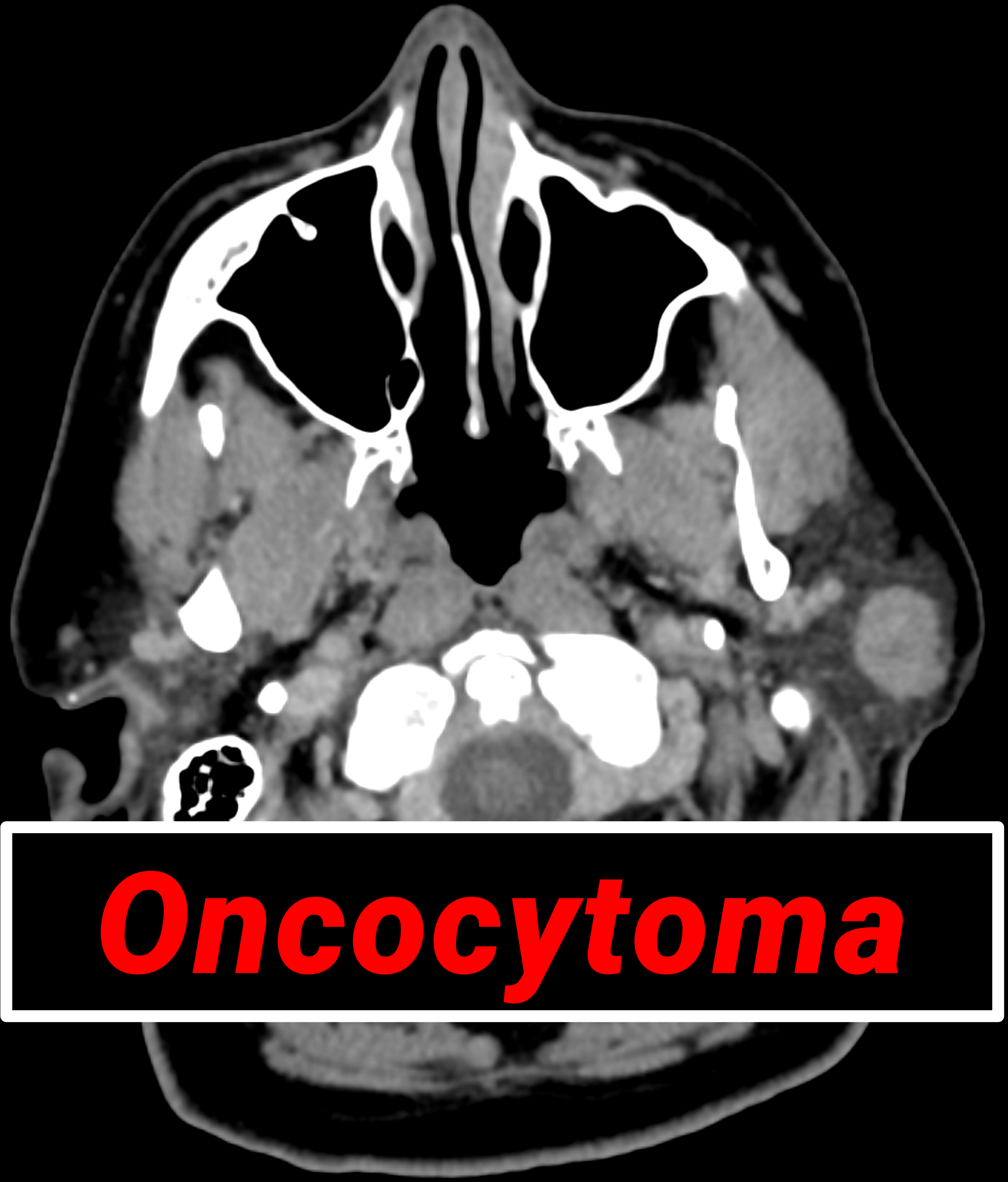
~~BMT~~

~~Warthin~~

~~Adenoid Cystic~~

~~Mucoep~~

~~Met LN~~



~~BMT~~

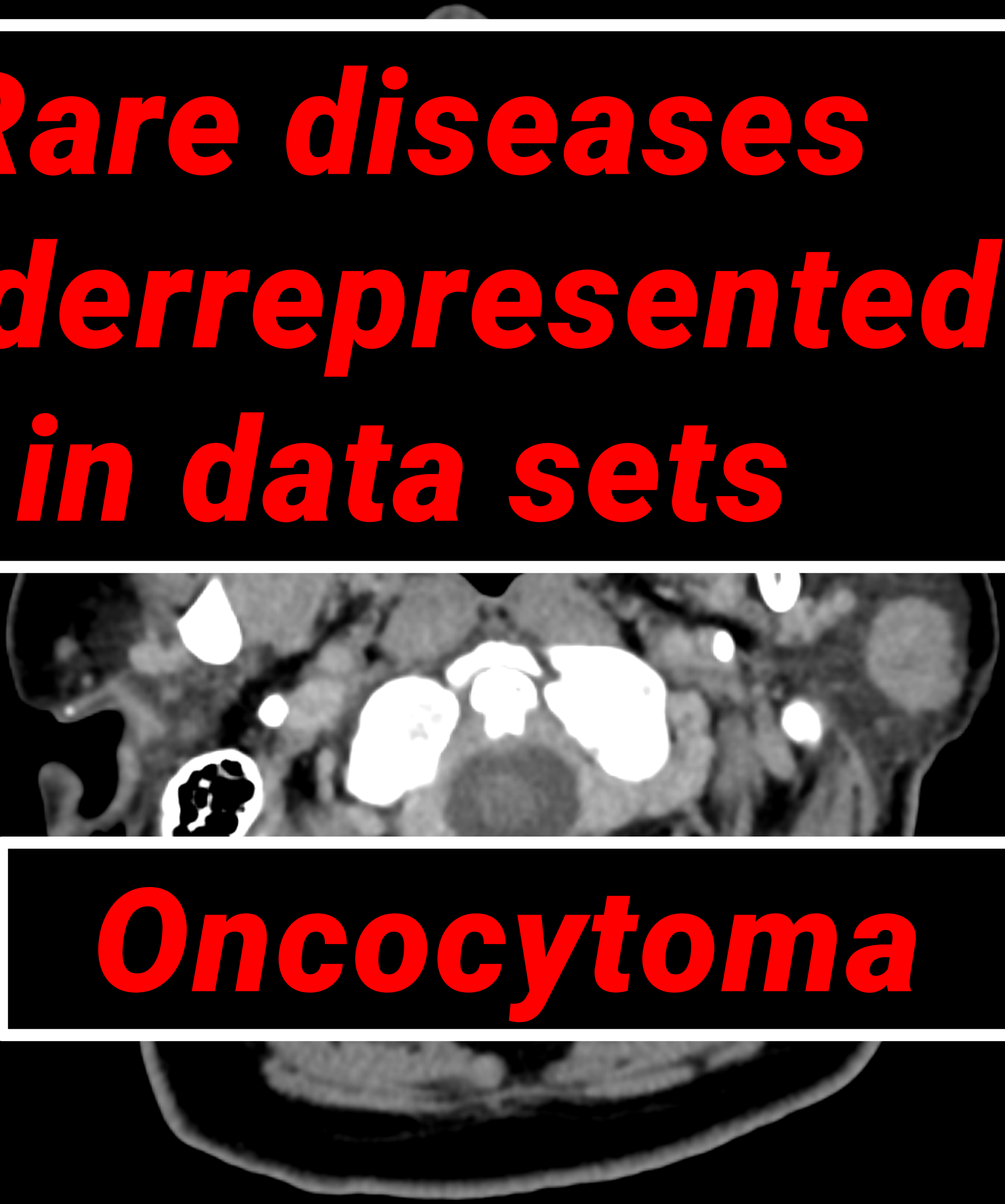
~~Warthin~~

~~Adenoid Cystic~~

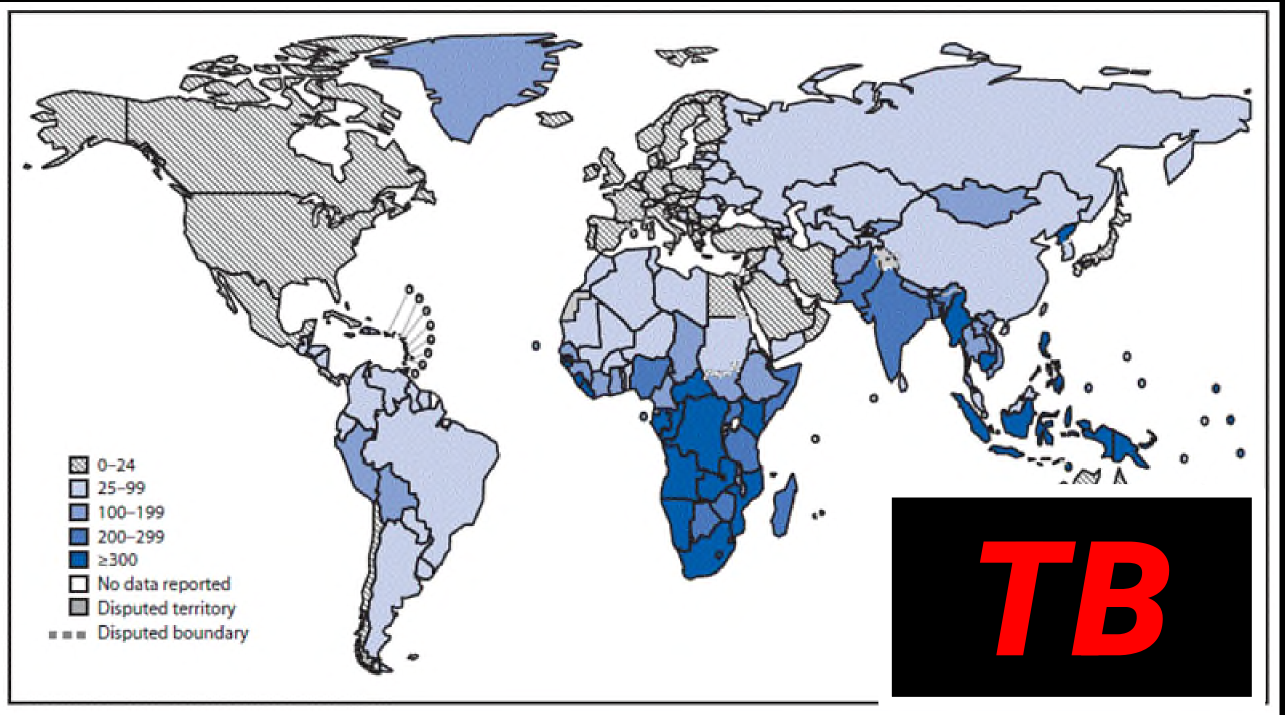
~~Mucoep~~

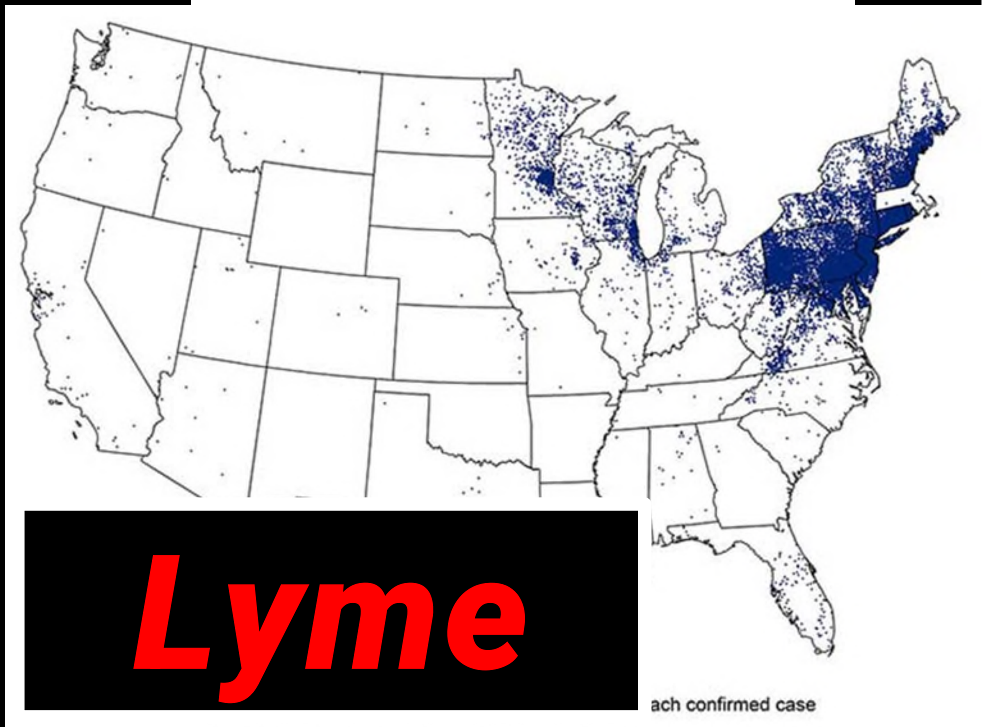
~~Met LN~~

**Rare diseases underrepresented in data sets**



**Oncocytoma**


0–24
25–99
100–199
200–299
≥300
No data reported
Disputed territory
Disputed boundary
TB


Lyme
ach confirmed case

## *Regulatory Approval*

- **Safety**
- **Technical performance**
- **Environment: controlled**

## *Clinical Adoption*

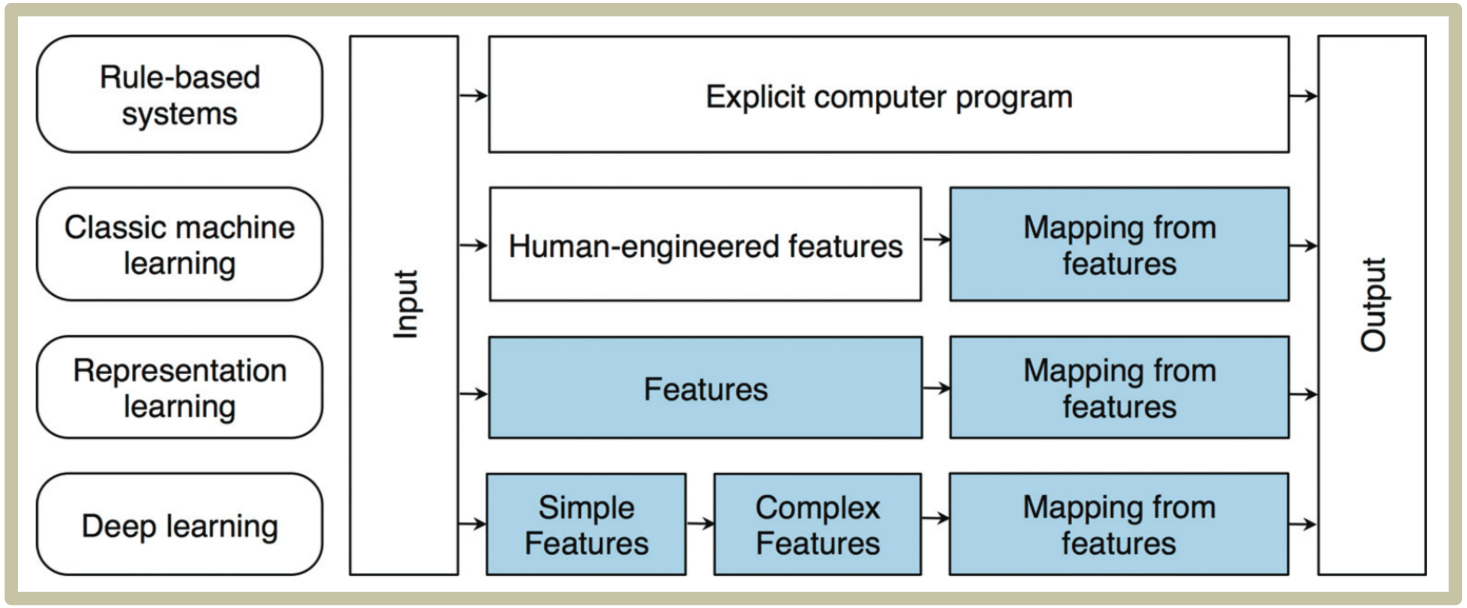
- **Integration**
- **User friendliness**
- **Solving clinical problem**
- **Environment: unpredictable**

# *Other Limitations*

## Transparency

## Data Security

## Liability



# *Other Limitations*

Transparency

**Data Security**

Liability

# Other Limitations

Transparency

Data Security

**Liability**

The NEW ENGLAND JOURNAL of MEDICINE

HEALTH LAW, ETHICS, AND HUMAN RIGHTS

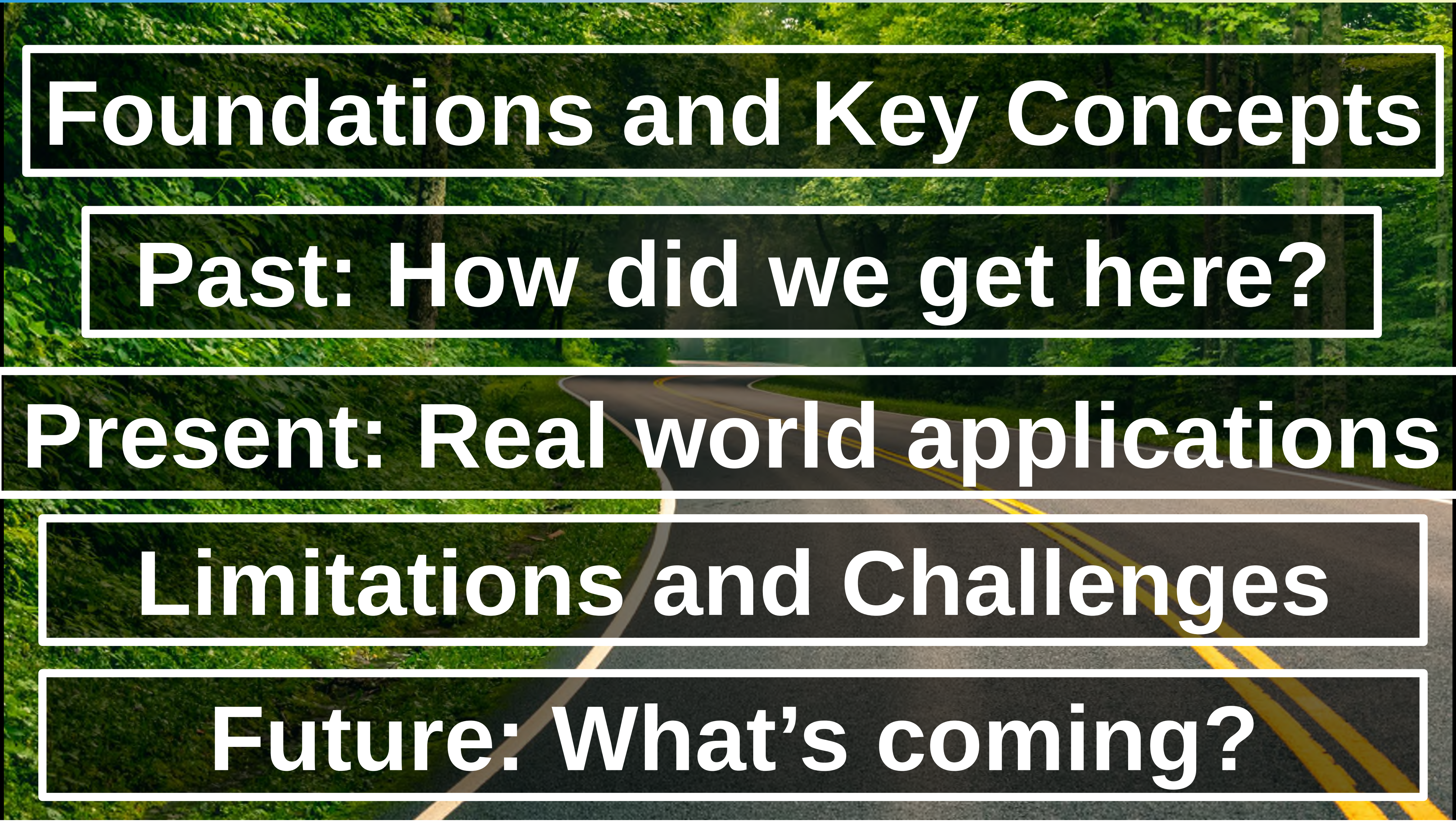
## Understanding Liability Risk from Using Health Care Artificial Intelligence Tools

Michelle M. Mello, J.D., Ph.D., and Neel Guha, M.S.

Optimism about the explosive potential of artificial intelligence (AI) to transform medicine is tempered by worry about what it may mean for the clinicians being "augmented." One question is especially problematic because it may chill adoption: when AI contributes to patient injury, who will be held responsible? injury claims result in written opinions. As this area of law matures, it will confront several challenges.

Ordinarily, when a physician uses or recommends a product and an injury to the patient results, well-established rules help courts allocate liability among the physician, product maker,

*N Engl J Med*. 2024

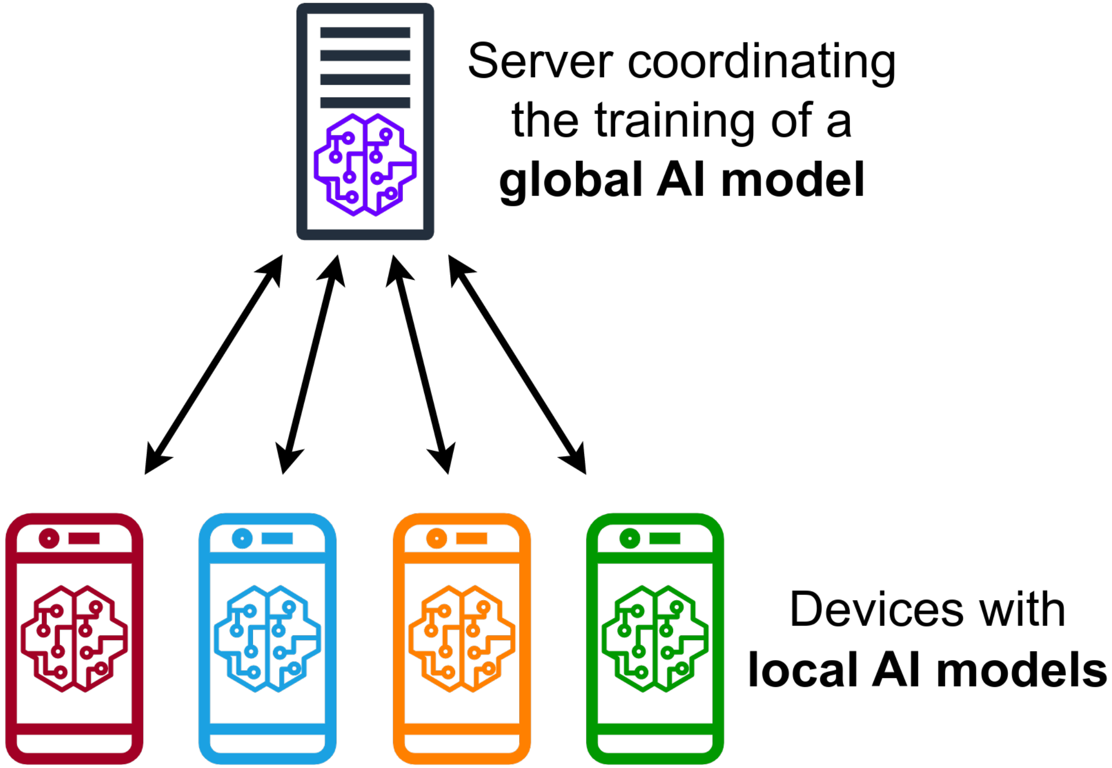

Foundations and Key Concepts
Past: How did we get here?
Present: Real world applications
Limitations and Challenges
Future: What’s coming?

# FUTURE DIRECTIONS

## Federated Learning

## Foundation Models

## Human – AI collaboration

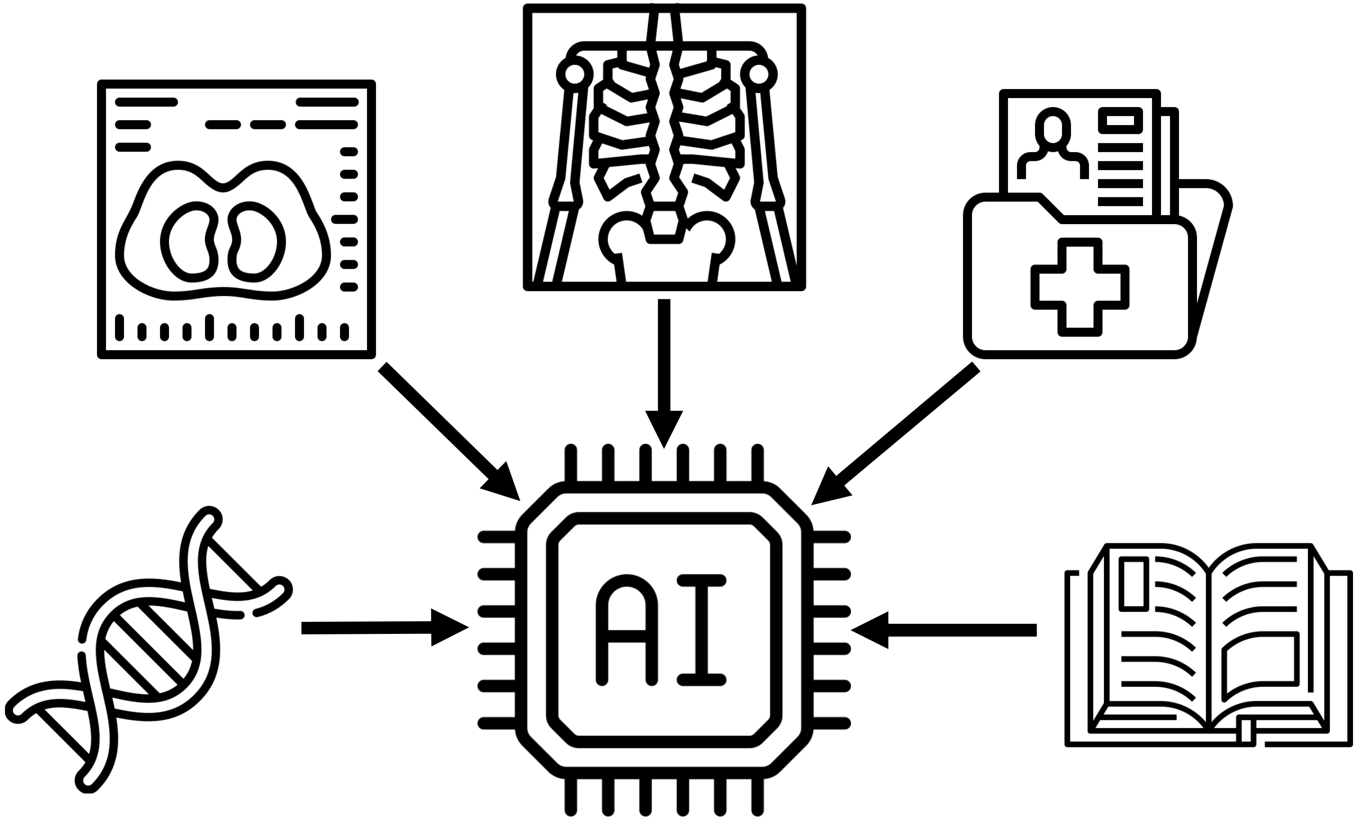


# FUTURE DIRECTIONS

Federated Learning

**Foundation Models**

Human – AI collaboration



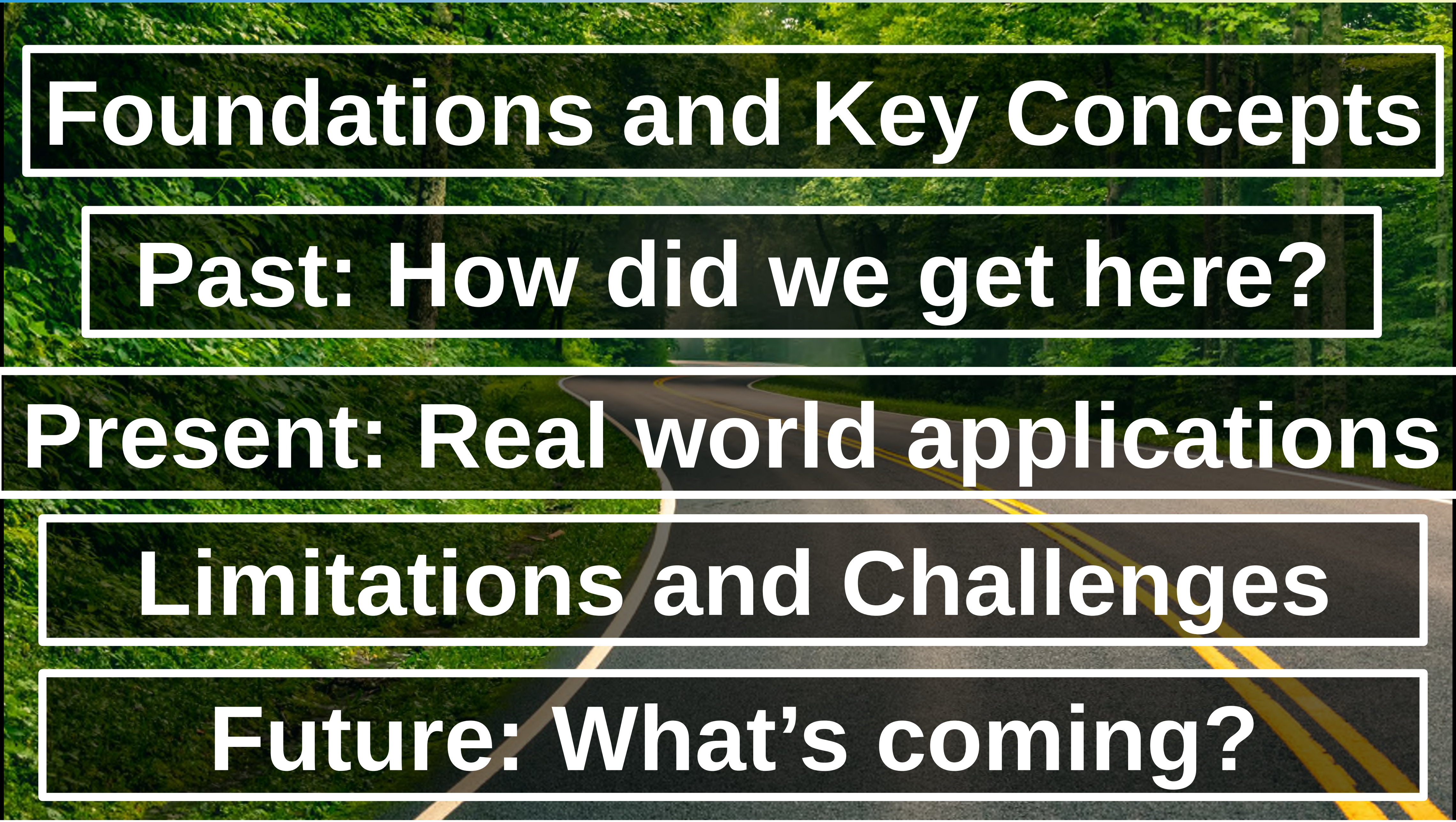
# *FUTURE DIRECTIONS*

Federated Learning

Foundation Models

**Human – AI collaboration**

Photo by Cash Macanaya on Unsplash


Foundations and Key Concepts
Past: How did we get here?
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# *FUTURE DIRECTIONS*

**AI can augment imaging and medicine to improve health outcomes**

**Must fit into our workflows or we must adapt**

**Focus on biases prevent unnecessary harm**

**Rapid development – rapid learning!**

Multidisciplinary Approaches to Cancer Symposium

# Artificial Intelligence and the Future of Imaging

Luke Ledbetter, MD

Clinical Professor, Department of Radiology

Vice Chair of Education, Department of Radiology

Neuroradiology Section Chief

City of Hope