Advanced Imaging: What you Can't See, Will Hurt Your Patient

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DISCLOSURE

Omid Jazaeri, MD, RPVI, FACS, FSMB

- No relevant financial relationship reported

Discovering the Inside

INNOVATIONS IN MEDICAL IMAGING AND RADIATIO

This National Radiologic Technology Week®, travel back in time and relive the history of the radiologic technology profession and the American Society of Radiologic Technologists through ASRT Museum and Archives exhibits.

1895
German physicist
x-ray and within

1896
First clinical use

1903
First use of rad

1904
Thomas Edison's
radiation exposu

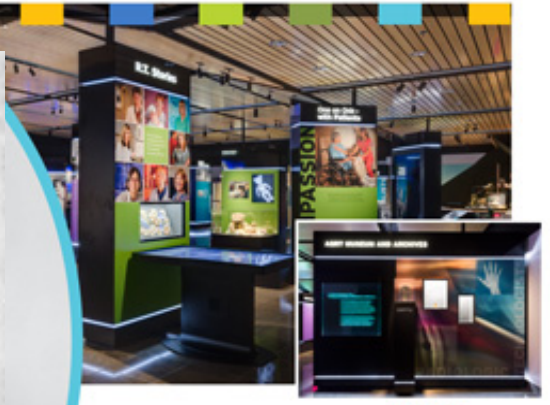
1913
Known for his many contributions t
William Coolidge invents the heate
enabling external beam radiotherap

1914
Marie Curie designs vehicles to carr
equipment to the battlefield in Wo

1920
American Association of Radiological
Technicians established; known today
American Society of Radiologic Techn

1927
Thirty-seven percent of all radiologic technologists are nuns.

1941
The U.S. military trains thousands of servicemen as radiographers to provide care for wounded soldiers overseas du World War II.



2015
ASRT Museum and Archives opens.

2011
First clinical 3-D mamm ography exam
perfor

1992
Congress enacts the Mammography Quality Standards Act ensuring all women have access to quality mammography.

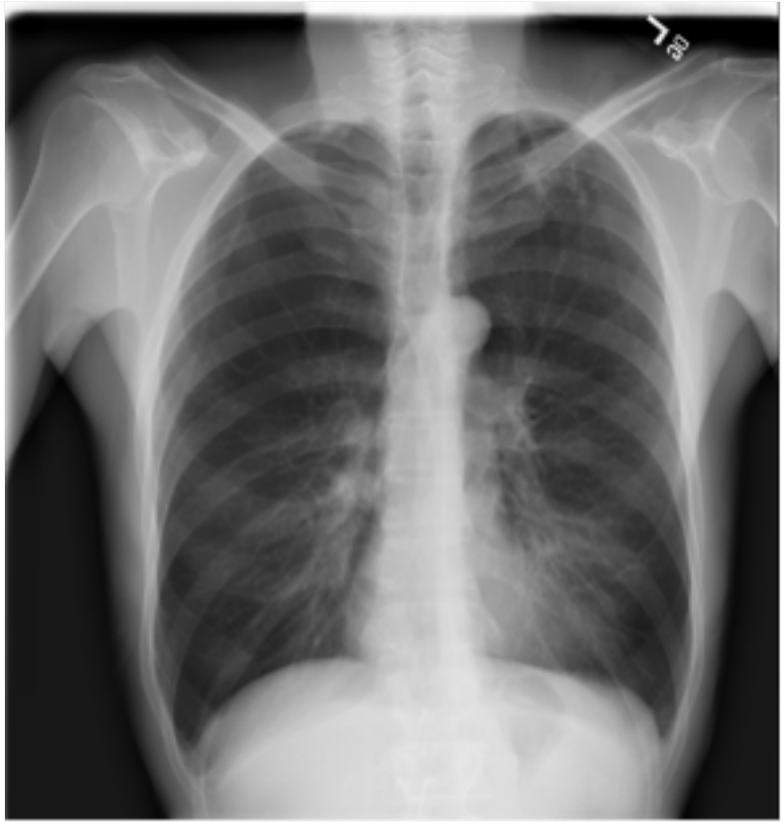
1983
ASRT opens new national office in Albuquerque, New Mexico.

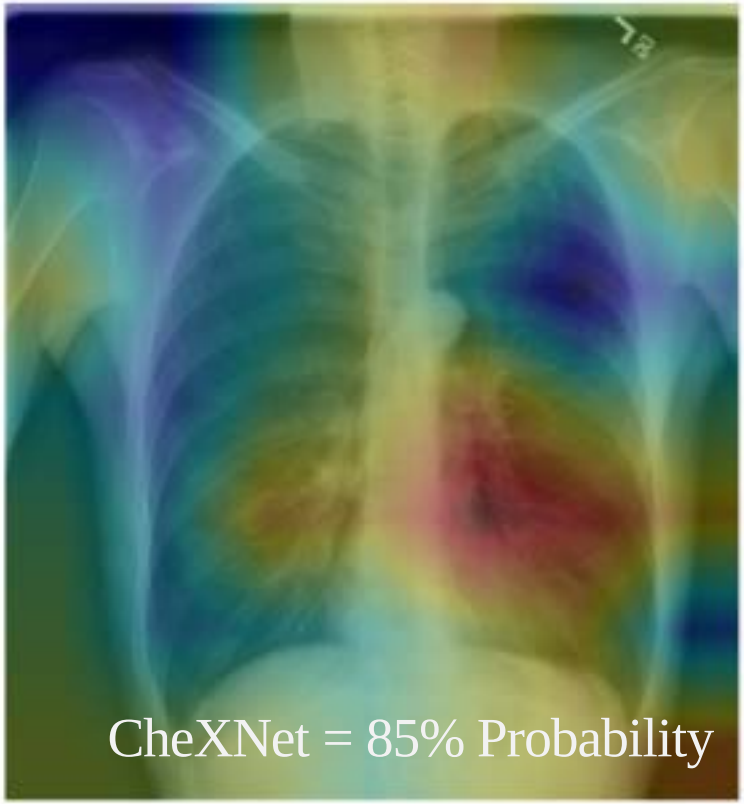
1979
Allan Cormack and Godfrey Hounsfield awarded Nobel Prize in Medicine for invention of computed tomography.

977
Raymond V. Damadian, Lawrence Minkoff and Michael
MRI scanner makes the first-ever MR image.

asrt Museum and Archives

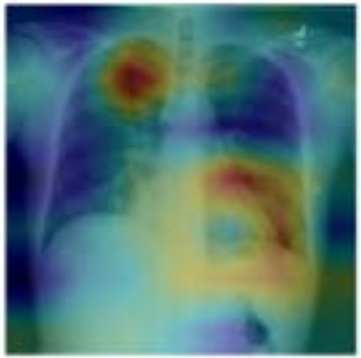
Artificial Intelligence in Medicine & Imaging



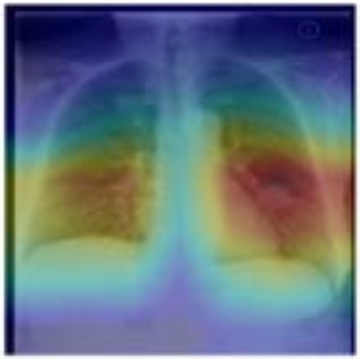


arXiv.org

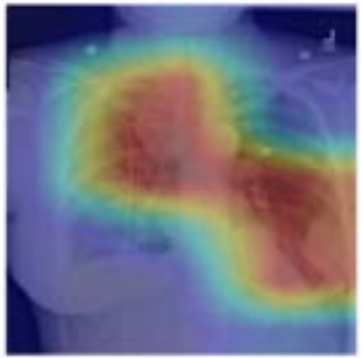
CheXNet: Radiologist-Level Pneumonia Detection on Chest X-Rays with Deep Learning



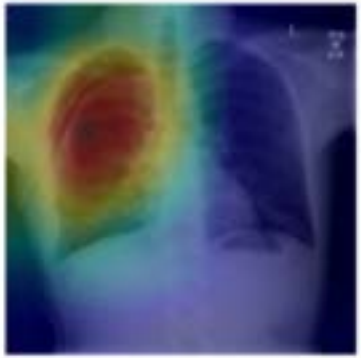
(a) Patient with multifocal community acquired pneumonia. The model correctly detects the airspace disease in the left lower and right upper lobes to arrive at the pneumonia diagnosis.



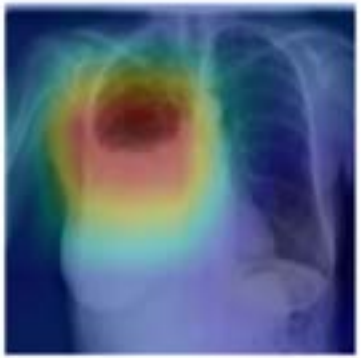
(b) Patient with a left lung nodule. The model identifies the left lower lobe lung nodule and correctly classifies the pathology.



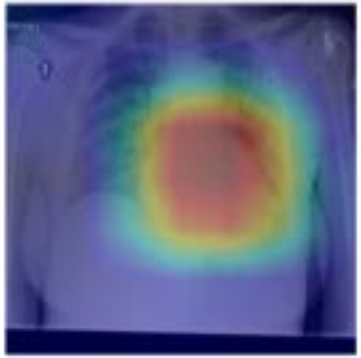
(c) Patient with primary lung malignancy and two large masses, one in the left lower lobe and one in the right upper lobe adjacent to the mediastinum. The model correctly identifies both masses in the X-ray.



(d) Patient with a right-sided pneumothroax and chest tube. The model detects the abnormal lung to correctly predict the presence of pneumothorax (collapsed lung).



(e) Patient with a large right pleural effusion (fluid in the pleural space). The model correctly labels the effusion and focuses on the right lower chest.



(f) Patient with congestive heart failure and cardiomegaly (enlarged heart). The model correctly identifies the enlarged cardiac silhouette.

arXiv.org

Conclusion

- *"We developed an algorithm which **exceeds the performance of radiologists in detecting pneumonia from frontal-view chest X-ray images**. We also show that a simple extension of our algorithm to detect multiple diseases outperforms previous state of the art on ChestX-ray14, the largest publicly available chest X- ray dataset…."*

Advanced Imaging: What you Can't See, Will Hurt Your Patient

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Artificial Intelligence: What you Can't Interpret, Will Hurt Your Patient

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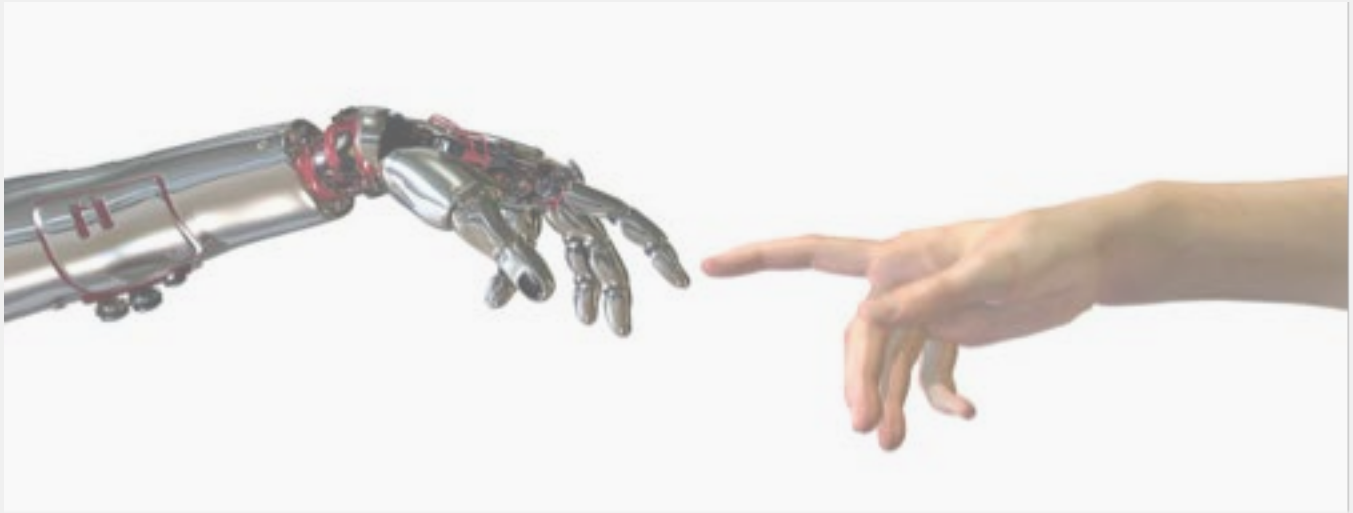
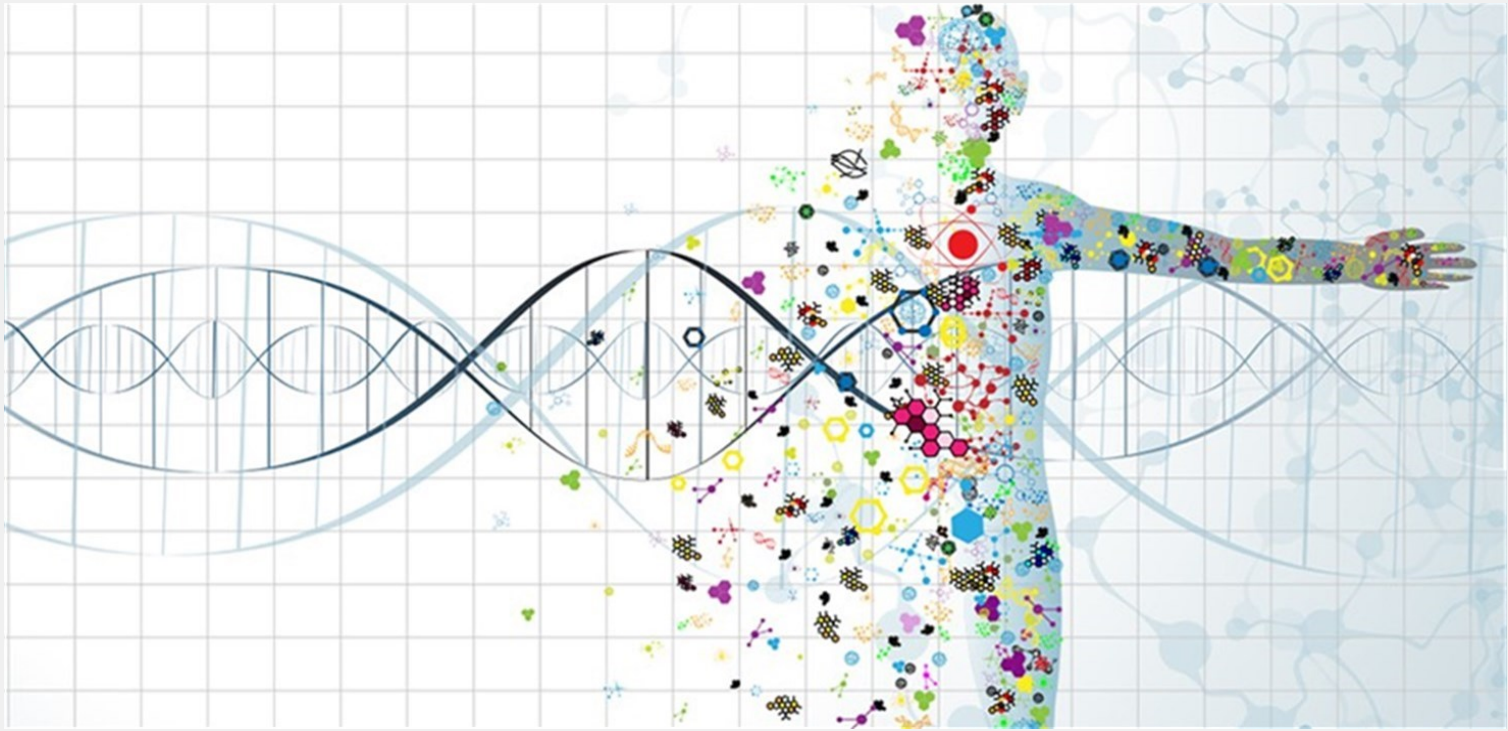
Artificial Intelligence

- **Definition:** Any device that perceives its environment and takes actions that maximize its chance of success at some goal.

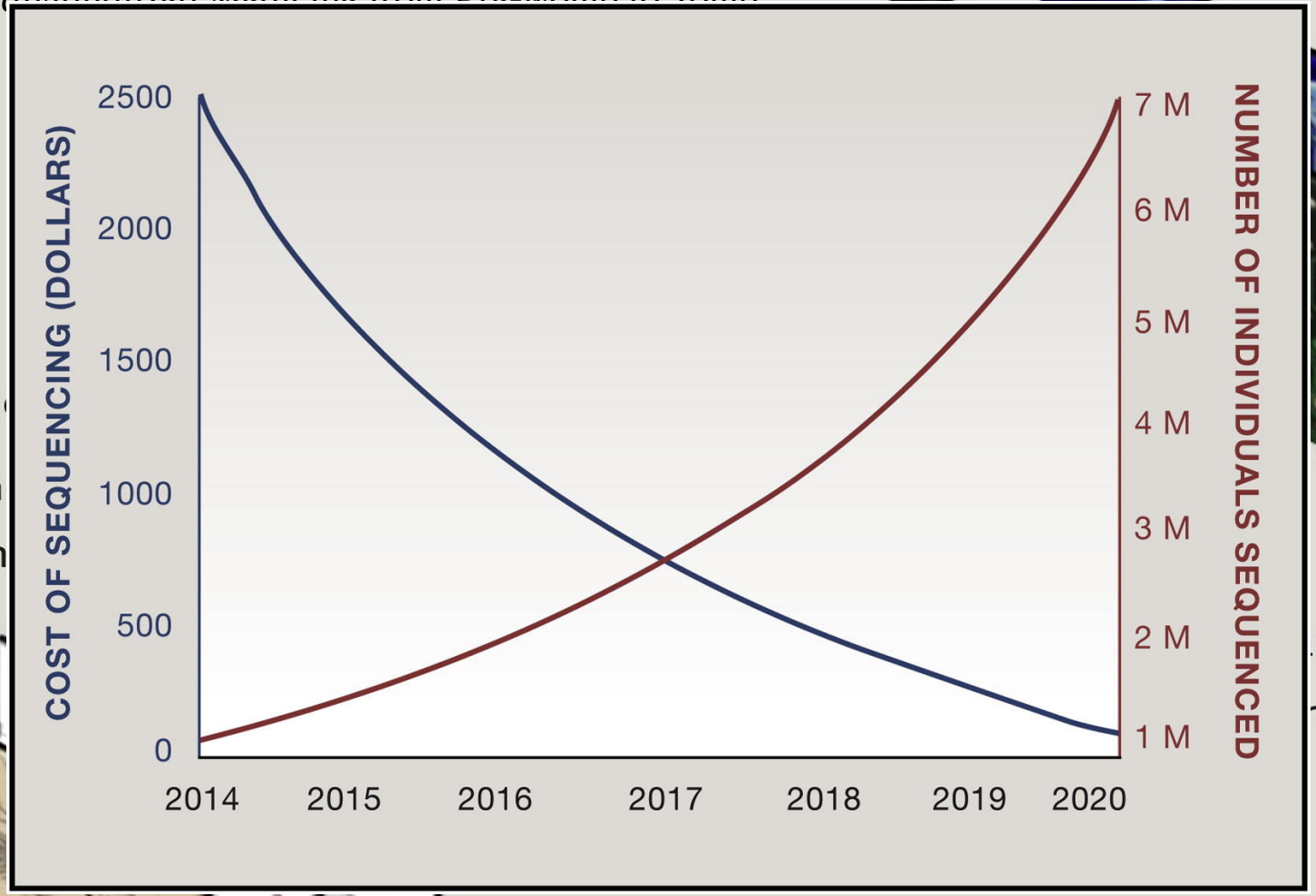


Artificial Intelligence

Artificial Intelligence, Big-Data, Machine learning and "Deep Learning"



Individualized Medicine from Pre-womb to Tomb



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Epigen

Exposom

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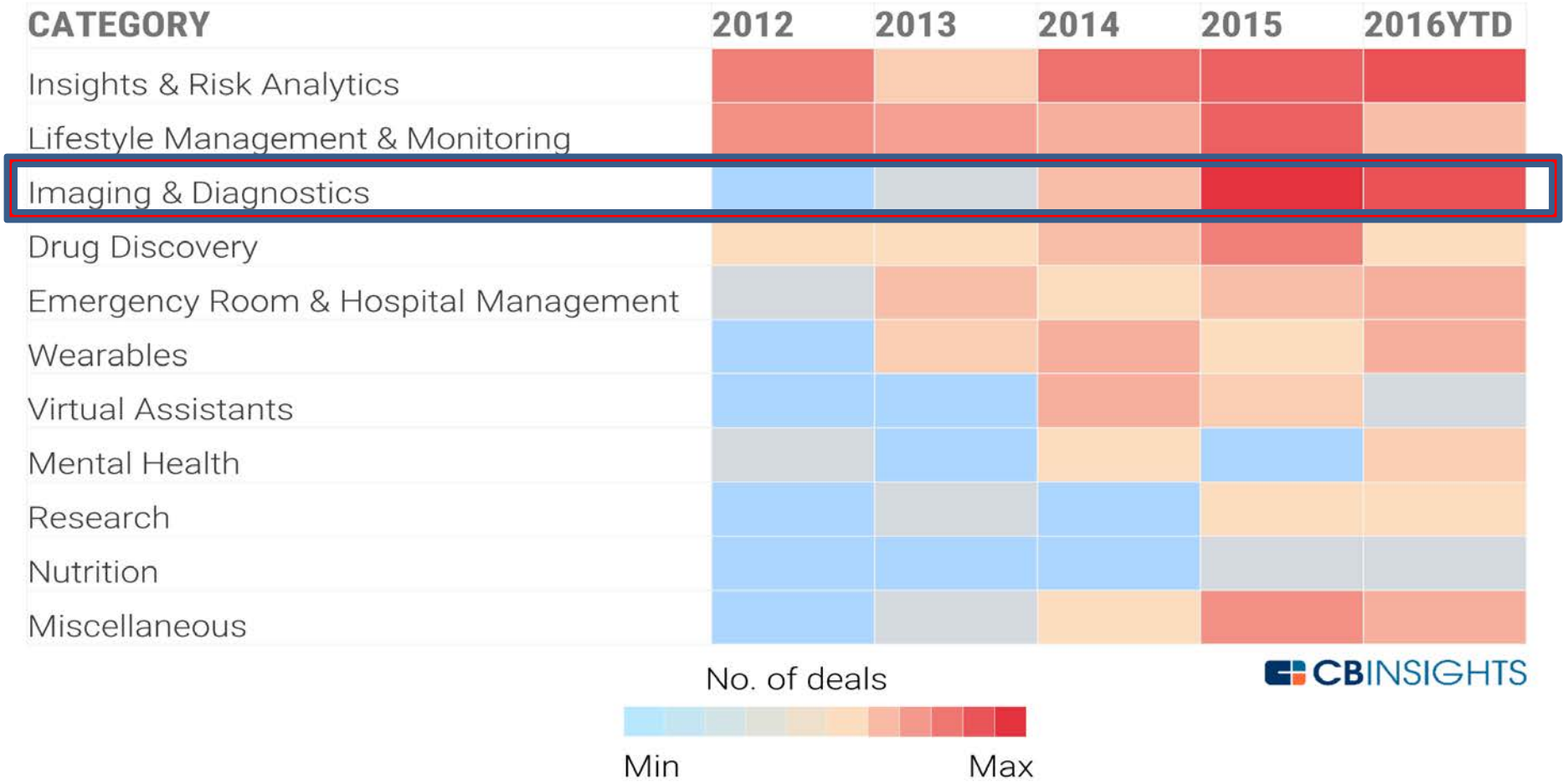
Cell. Volume 157, Issue 1, Pages 241-253.3/2014

AI IN HEALTHCARE: CATEGORY HEATMAP

2012-2016 (as of 8/30/2016)



https://www.cbinsights.com/research/artificial-intelligence-healthcare-investment-heatmap/

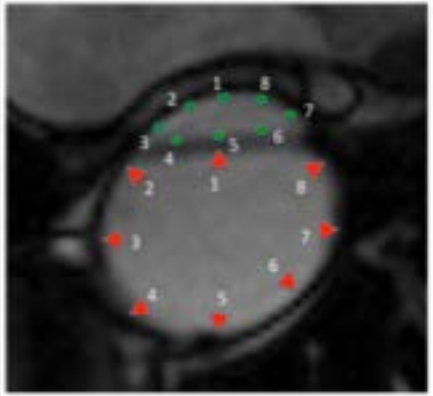
The Problem With Big-Data

- Algorithms used biased data
  - » Racial, religious, gender-general
  - » Education, location, profession-specific
- Transparency
  - » Show your work
- Accountability
  - » AI vs Human

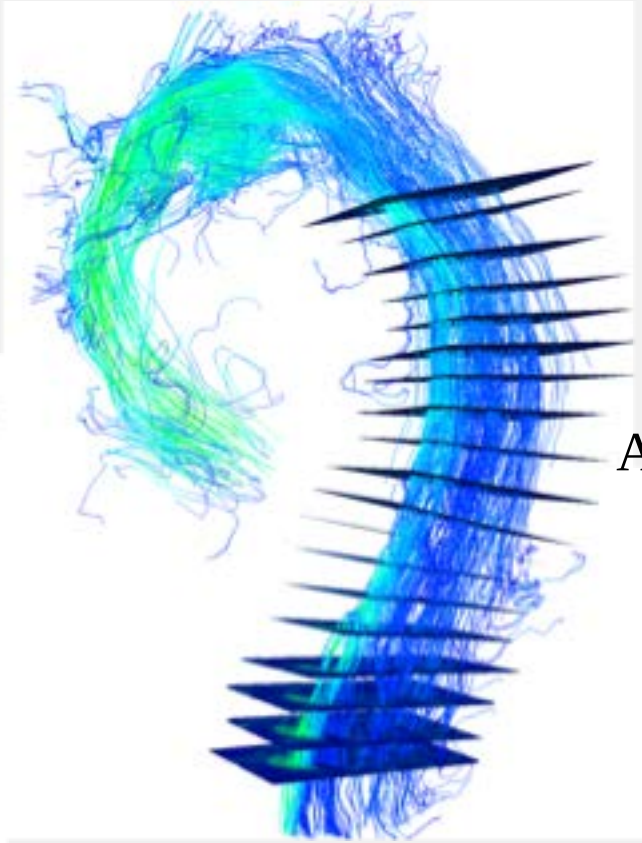
"Deep Learning"

- Medical Applications in Imaging
  - Diagnostic Radiology
  - Tumor Detection-Pathology
  - Tracking Tumor Development-Pathology
  - Diabetic Retinopathy
  - Genomics-Personalized Medicine
  - Blood Flow Quantification and Blood Vessel Visualization

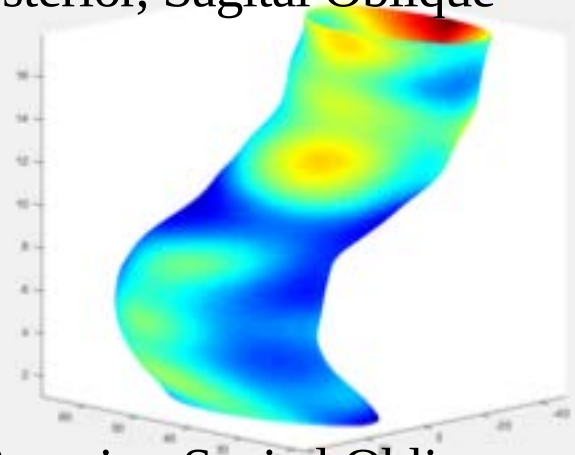
Blood Flow Quantification and Visualization



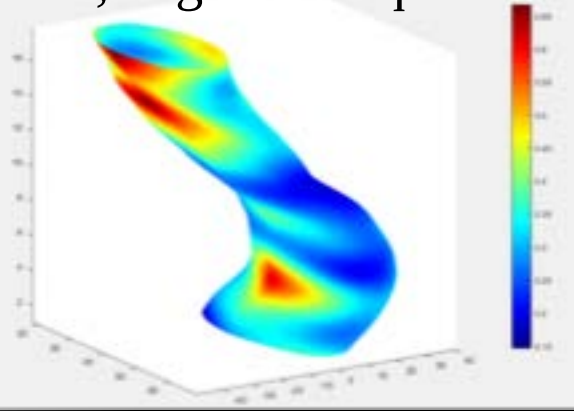
In-plane WSS	True Lumen	False Lumen
a	0.27 (0.16 - 0.38)	0.07 (0.05 - 0.11)
b	0.33 (0.27 - 0.36)	0.10 (0.07 - 0.13)
c	0.33 (0.25 - 0.39)	0.10 (0.05 - 0.14)
d	0.31 (0.24 - 0.41)	0.14 (0.11 - 0.16)
e	0.29 (0.24 - 0.43)	0.09 (0.07 - 0.16)
f	0.26 (0.21 - 0.32)	0.10 (0.07 - 0.11)
g	0.25 (0.22 - 0.28)	0.09 (0.07 - 0.11)
h	0.30 (0.23 - 0.38)	0.11 (0.09 - 0.13)
i	0.24 (0.18 - 0.34)	0.08 (0.07 - 0.12)
j	0.19 (0.15 - 0.25)	0.07 (0.05 - 0.11)
k	0.25 (0.17 - 0.34)	0.09 (0.07 - 0.12)
l	0.34 (0.28 - 0.43)	0.11 (0.08 - 0.15)
m	0.37 (0.31 - 0.54)	0.10 (0.08 - 0.14)
n	0.44 (0.33 - 0.50)	0.11 (0.10 - 0.12)
o	0.39 (0.32 - 0.58)	0.09 (0.06 - 0.14)
p	0.32 (0.27 - 0.39)	0.12 (0.09 - 0.13)
q	0.37 (0.28 - 0.55)	0.09 (0.06 - 0.12)
r	0.44 (0.38 - 0.50)	0.11 (0.09 - 0.14)



Posterior, Sagital Oblique



Anterior, Sagital Oblique



Association of variant arch anatomy with type B aortic dissection and hemodynamic mechanisms

Sherene Shalhub, MD, MPH, FACS,[a] Michal Schäfer, MSc,[b] Thomas S. Hatsukami, MD, FACS,[a]
Matthew [illegible] RCSI,[c]
Susanna [illegible]
Benjamin [illegible] Aurora, Colo;
and Dubin[illegible]

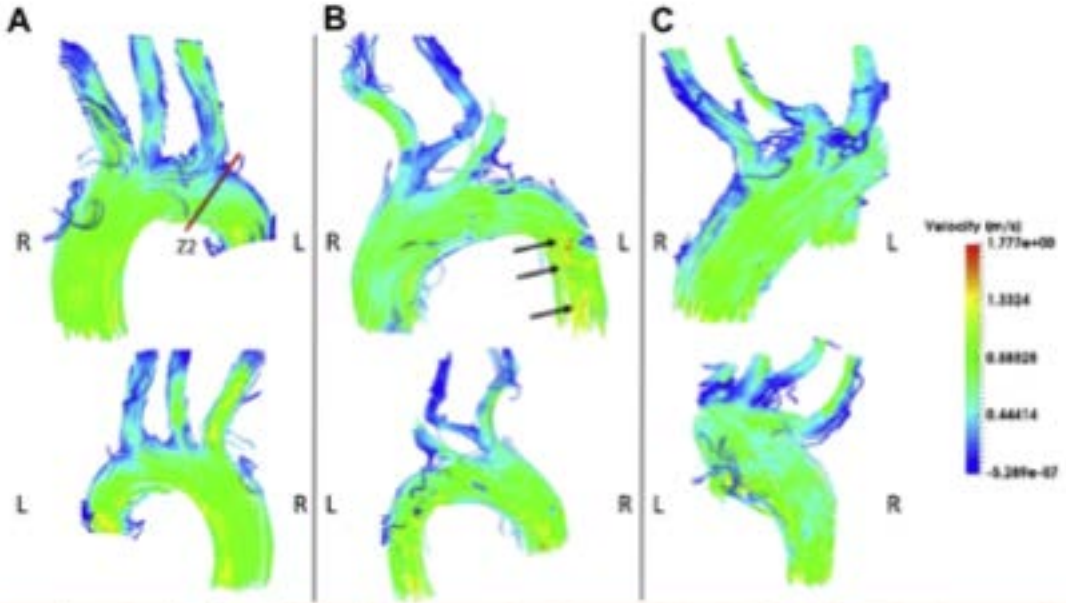


Fig 2. Streamline visualization of three different aortic arch morphologies from three healthy controls via four-dimensional flow magnetic resonance imaging (4D flow MRI). **(A)** Conventional aortic arch revealing uniform velocity distribution at the distal portion of the aortic arch. **(B)** Bovine aortic arch presented significant flow acceleration at the region of the inner curve (*arrows*), creating elevated regional wall shear stress. **(C)** Aberrant right subclavian aortic arch revealed relatively.

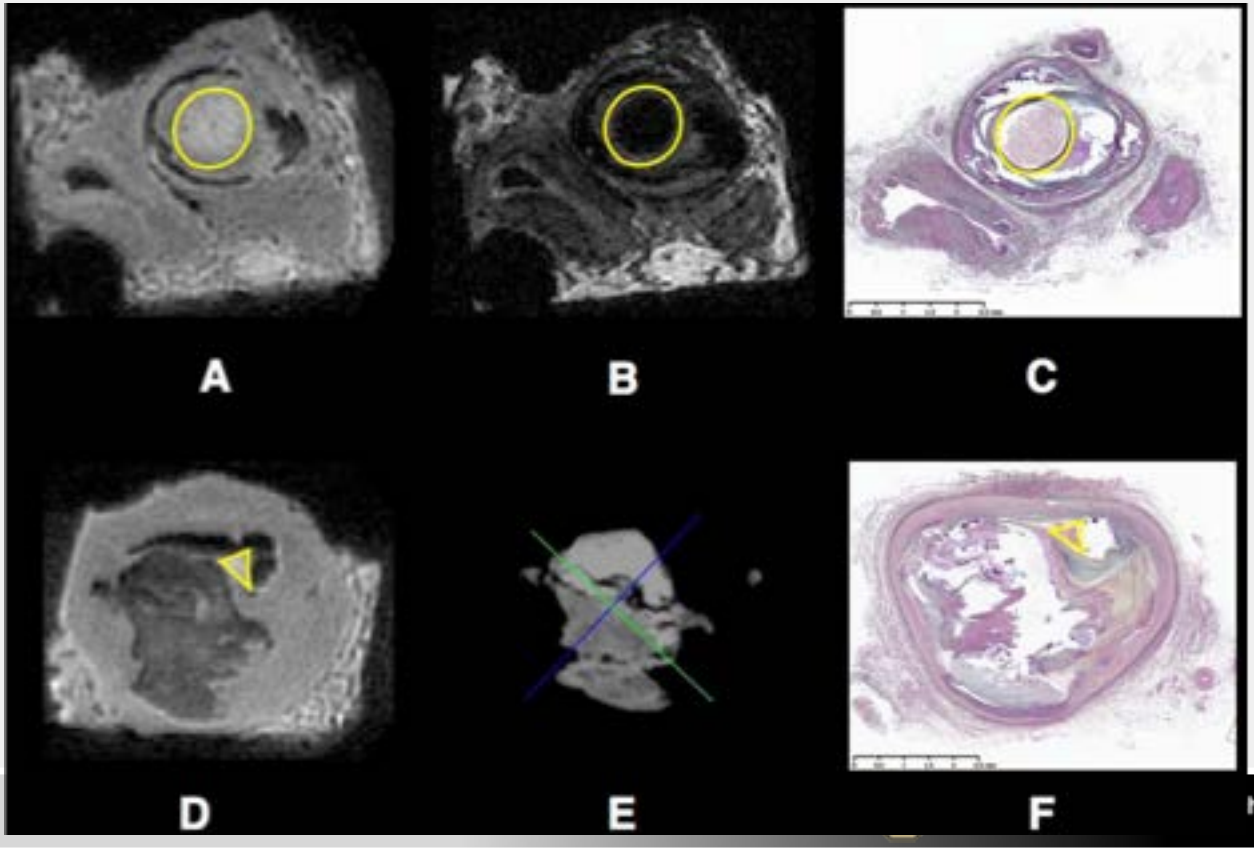
2018 May 24.

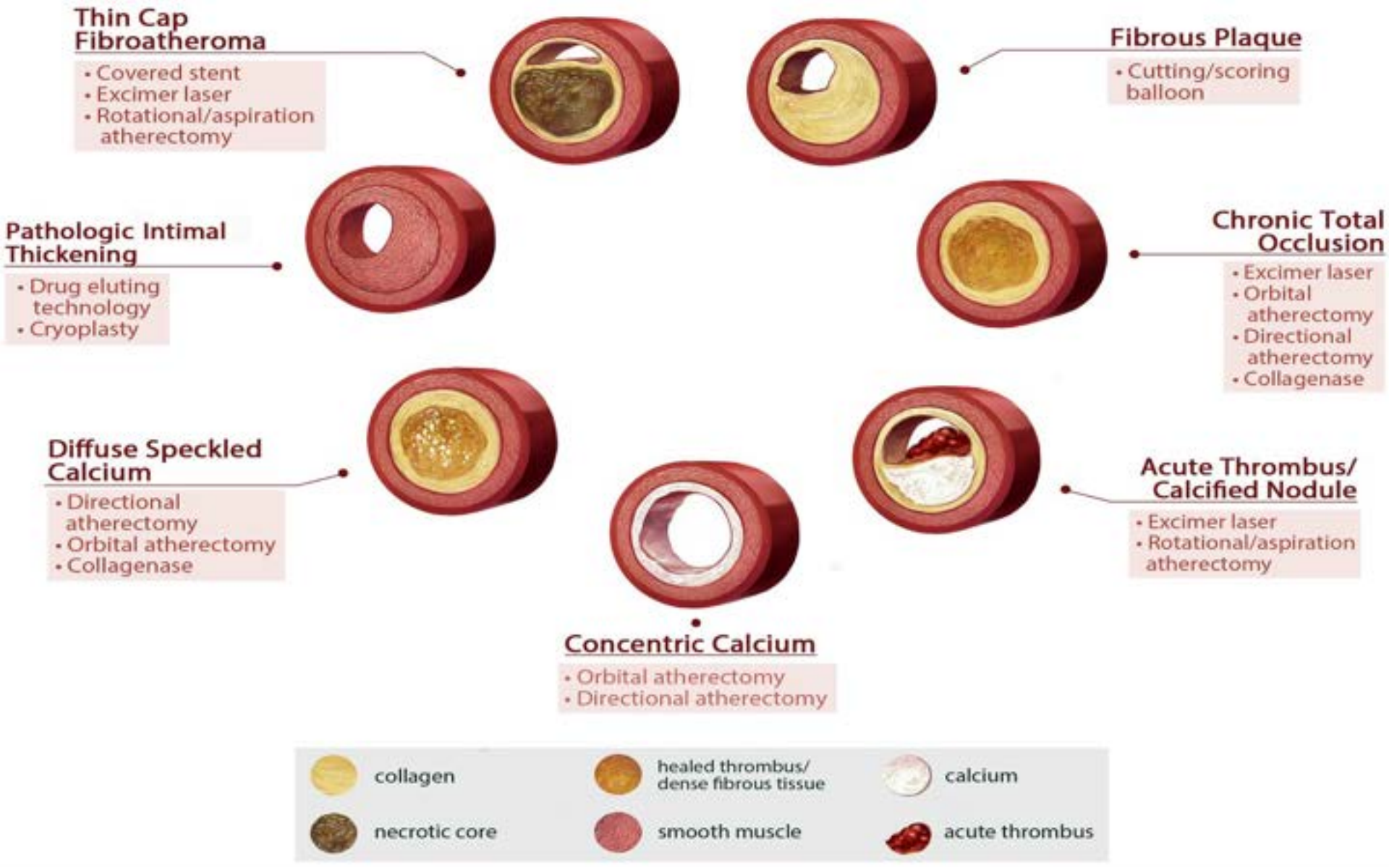
Peripheral Endovascular Interventions in the Era of Precision Medicine: Tying Wire, Drug, and Device Selection to Plaque Morphology

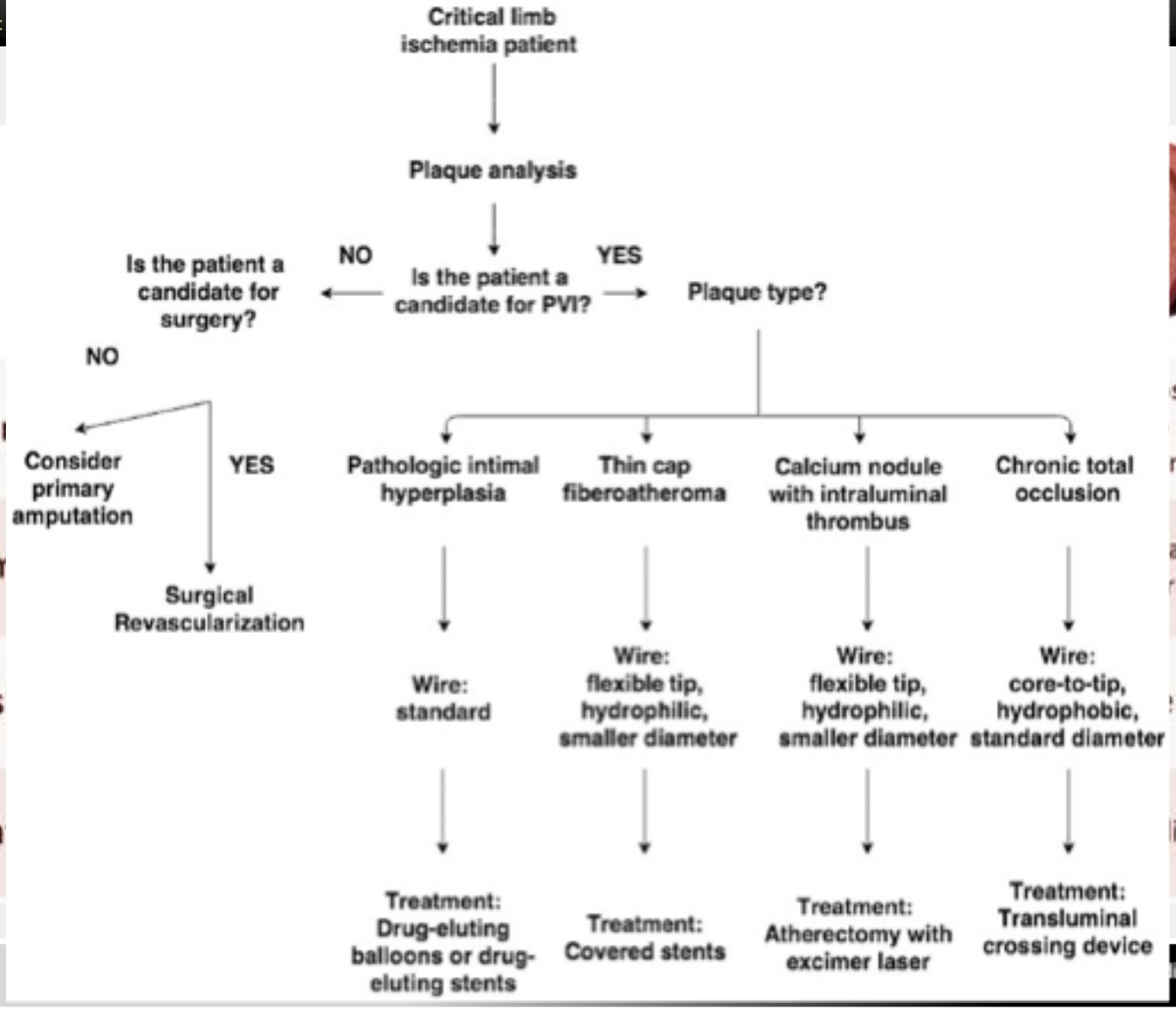
Journal of Endovascular Therapy
2016, Vol. 23(5) 751–761

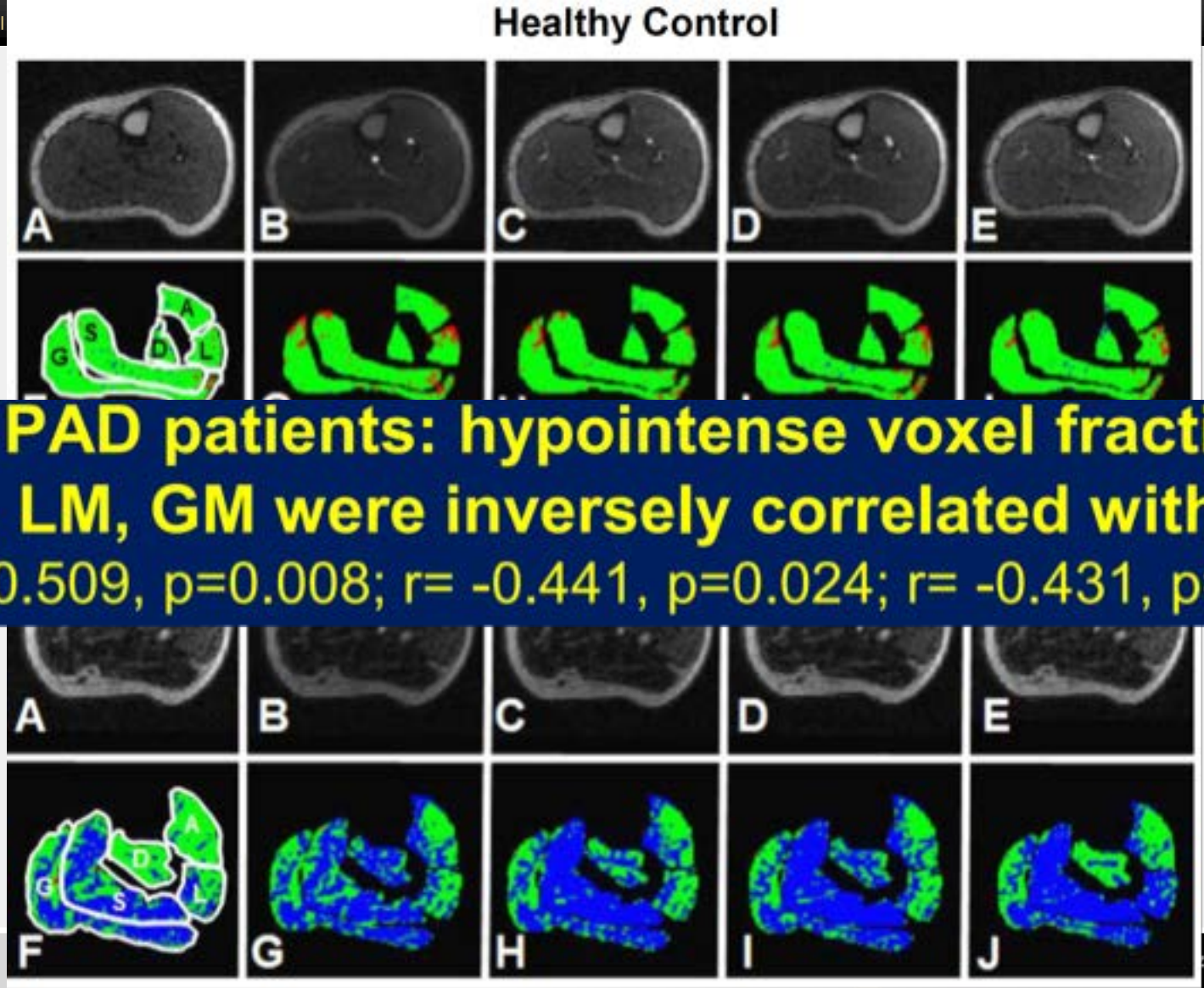
DOI: 10.1177/1526602816653221
www.jevt.org
SAGE

Trisha Roy, MD[1,2], Andrew D. Dueck, MD, MSc[1,2], and Graham A. Wright, PhD[1,3]




Thin Cap Fibroatheroma
• Covered stent
• Excimer laser
• Rotational/aspiration atherectomy
Fibrous Plaque
• Cutting/scoring balloon
Pathologic Intimal Thickening
• Drug eluting technology
• Cryoplasty
Chronic Total Occlusion
• Excimer laser
• Orbital atherectomy
• Directional atherectomy
• Collagenase
Diffuse Speckled Calcium
• Directional atherectomy
• Orbital atherectomy
• Collagenase
Acute Thrombus/ Calcified Nodule
• Excimer laser
• Rotational/aspiration atherectomy
Concentric Calcium
• Orbital atherectomy
• Directional atherectomy
collagen
healed thrombus/ dense fibrous tissue
calcium
necrotic core
smooth muscle
acute thrombus


Critical limb ischemia patient
Plaque analysis
Is the patient a candidate for PVI?
NO
YES
Is the patient a candidate for surgery?
NO
Consider primary amputation
YES
Surgical Revascularization
Plaque type?
Pathologic intimal hyperplasia
Thin cap fibroatheroma
Calcium nodule with intraluminal thrombus
Chronic total occlusion
Wire: standard
Wire: flexible tip, hydrophilic, smaller diameter
Wire: flexible tip, hydrophilic, smaller diameter
Wire: core-to-tip, hydrophobic, standard diameter
Treatment: Drug-eluting balloons or drug-eluting stents
Treatment: Covered stents
Treatment: Atherectomy with excimer laser
Treatment: Transluminal crossing device

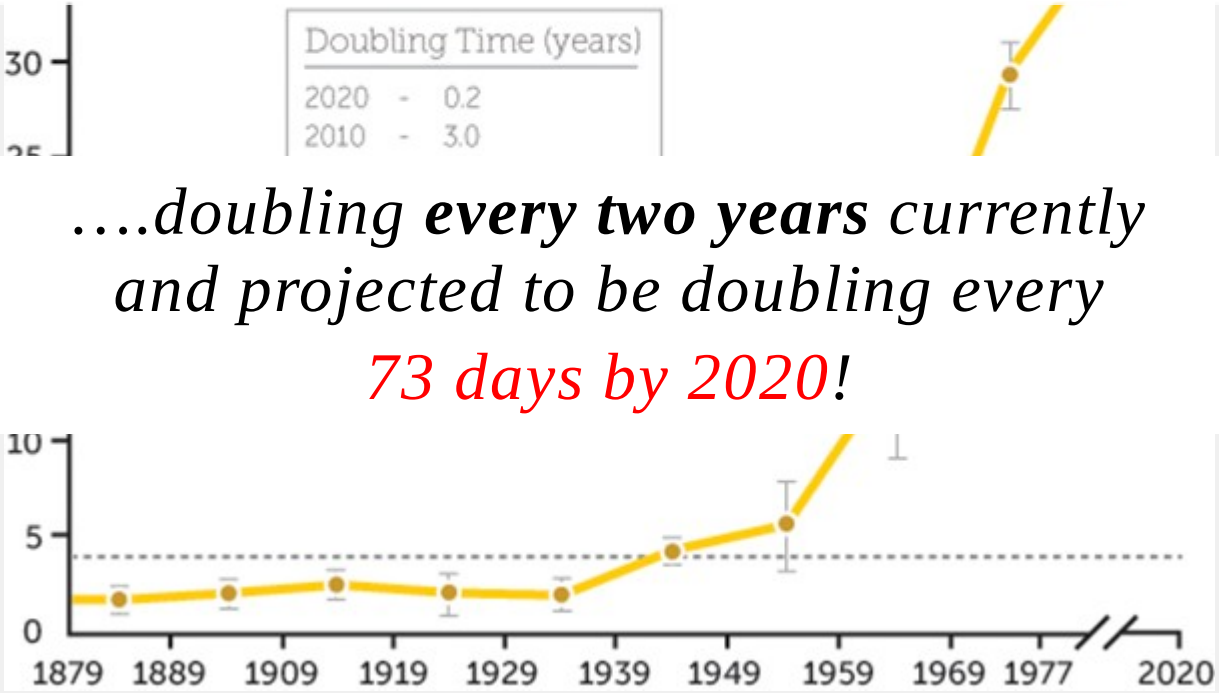


For PAD patients: hypointense voxel fractions of AM, LM, GM were inversely correlated with eGFR (r= -0.509, p=0.008; r= -0.441, p=0.024; r= -0.431, p=0.028).

CHALLENGES AND OPPORTUNITIES FACING MEDICAL EDUCATION

PETER DENSEN, MD

IOWA CITY, IOWA



*….doubling **every two years** currently and projected to be doubling every*

73 days by 2020!

Transactions of The American Clinical and Climatological Association in 2011; 122: 48-58

How much effort is needed to keep up with the literature relevant for primary care?

By Brian S. Alper, MD, MSPH
editor@dynamicmedical.com
Research Assistant Professor

- 341 Journals
- 7287 articles published monthly
- 627.5 hours/month
- 87% of total available time in a month spent reviewing literature
- Only 3hours/day are left……

JAMA | Original Investigation

Diagnostic Assessment of Deep Learning Algorithms for Detection of Lymph Node Metastases in Women With Breast Cancer

Babak Ehteshami Bejnordi, MS; Mitko Veta, PhD; Paul Johannes van Diest, MD, PhD; Bram van Ginneken, PhD; Nico Karssemeijer, PhD; Geert Litjens, PhD; Jeroen A. W. M. van der Laak, PhD; and the CAMELYON16 Consortium

Conclusion

- In cross-sectional analyses that evaluated 32 algorithms submitted as part of a challenge competition, 7 deep learning algorithms showed greater discrimination than a panel of 11 Pathologists with an AUC of 0.994 (best algorithm) vs. 0.884 (best pathologist)

Summary

- Our current imaging paradigms are outdated at best
- AI is here to stay
- Deep Learning is important but task focused
- Avoid "trial and error"
- Know your own "Deep Blue" moment
- Take a break from drugs and devices

Thank You!