Artificial Intelligence & Predictive Analytics

- **Aalpen Patel**, MD, FSIR, Chair, Department of Radiology, Vice Chair, Informatics & Quality, Department of Radiology, Medical Director, 3D Imaging and Printing Laboratory, Geisinger Health System

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LEVERAGING ARTIFICIAL INTELLIGENCE FOR PATIENT ENGAGEMENT

Aalpen A. Patel, MD, FSIR
Chair, Department of Radiology
Medical Director – Artificial Intelligence
Medical Director – 3D Laboratory
Vice Chair, Radiology Informatics
Geisinger

PUTTING PATIENTS FIRST®
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Geisinger

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Presenter Contact Information:
Aalpen A. Patel, MD, FSIR
Chair, Department of Radiology
Medical Director of Artificial Intelligence
570-214-4171
aapatel@geisinger.edu

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Outline

- Geisinger and Data Assets
- Motivation for AI
- AI in Patient Engagement
  - Direct
  - Indirect

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Geisinger and Data Assets

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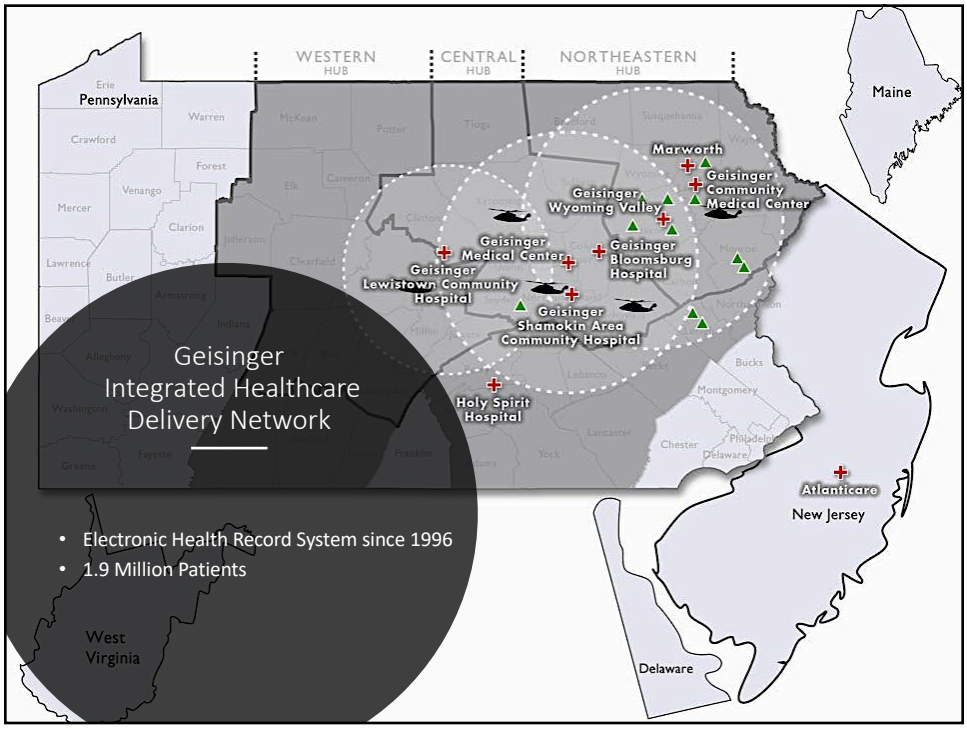

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Geisinger: Rich Clinical Data from Integrated Network of 13 Hospitals

1.9 Million patients
- ~500 Million labs
- >800 Million vital signs

3.2 Billion rows

~140,000 whole exomes sequenced
→ average **16 years** follow-up

2 Petabytes of Radiology and Cardiology Imaging Data

Epic Cerner (since 1996)

REGENERON GENETICS CENTER mycode

"Free phenotypic data" from a Learning Health System (Joe Leader, AVP of Informatics)

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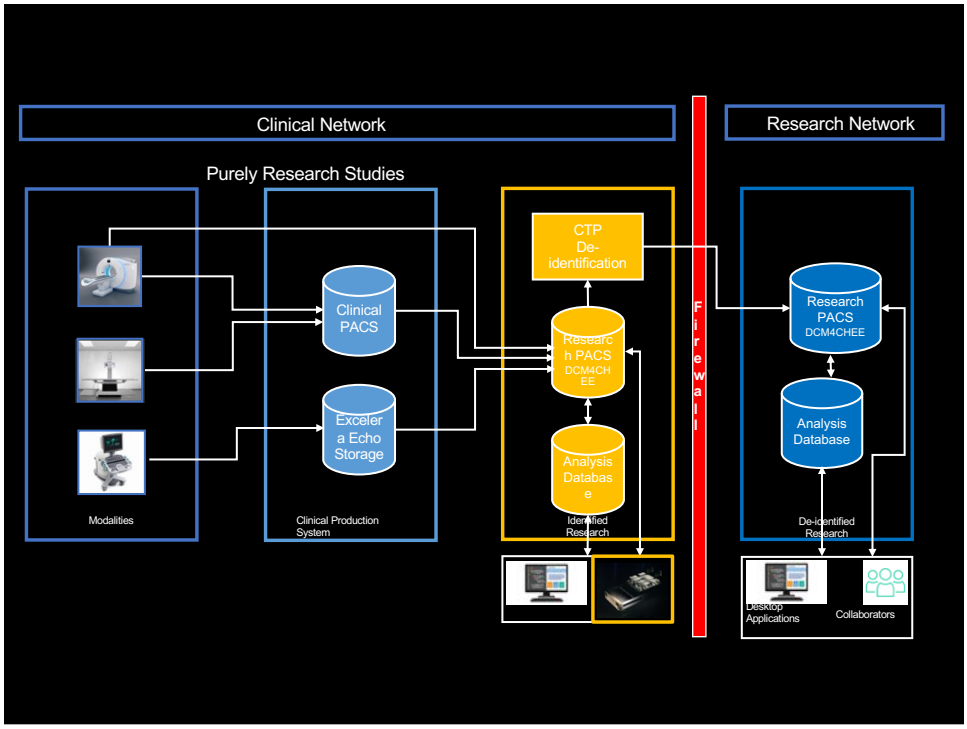
Clinical Network
Research Network
Purely Research Studies
Clinical PACS
Exceler a Echo Storage
CTP De-identification
Research PACS DCM4CHEE
Analysis Database
Research PACS DCM4CHEE
Analysis Database
Firewall
Modalities
Clinical Production System
Identified Research
De-identified Research
Desktop Applications
Collaborators

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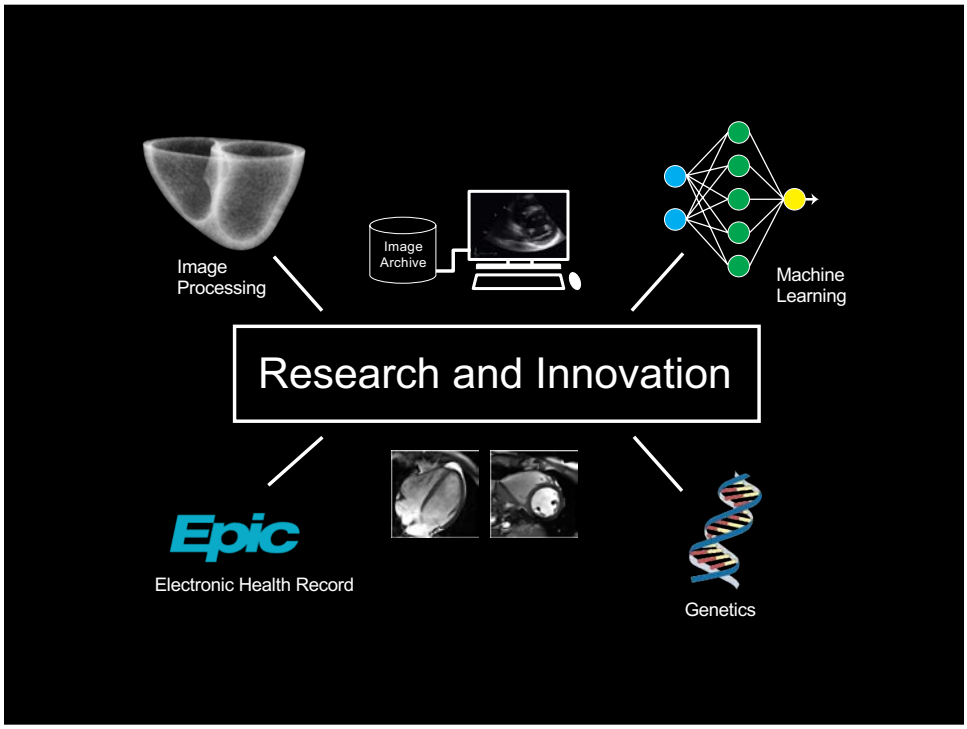
Image Processing
Image Archive
Machine Learning
Research and Innovation
Epic
Electronic Health Record
Genetics

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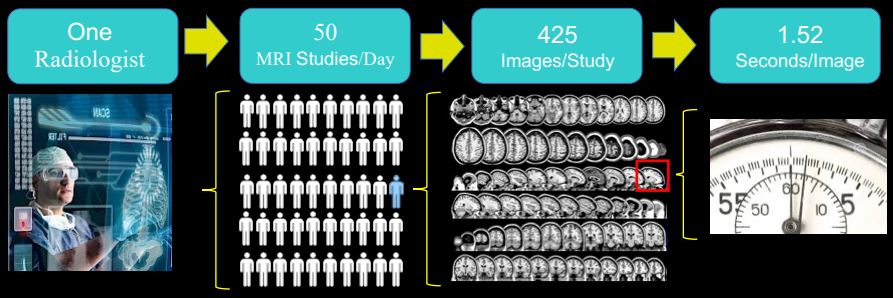
Motivation: Data Overload



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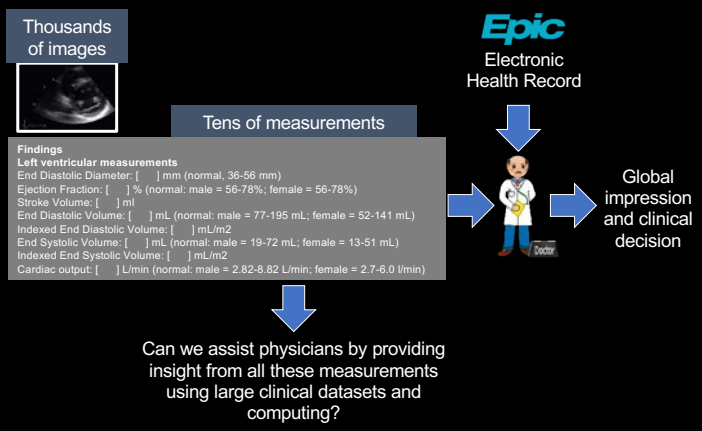
Motivation: Data Overload and Data Waste



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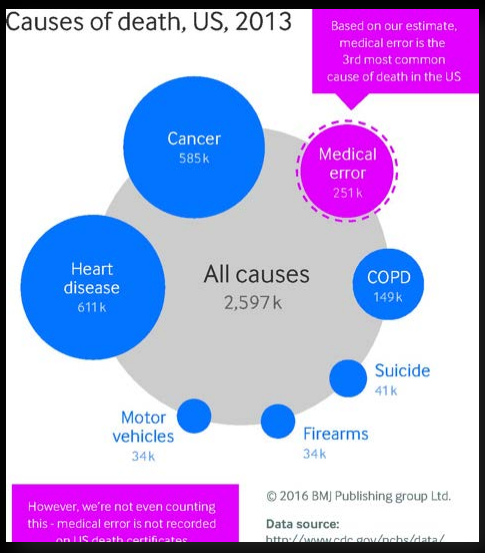
Medical Errors

- 3rd cause of death in the US
- Errors lead to
  - Decrease patient safety
  - Poor outcomes
  - Poor patient experience
  - Poor patient engagement



[http://www.bmj.com/content/353/bmj.i2139]

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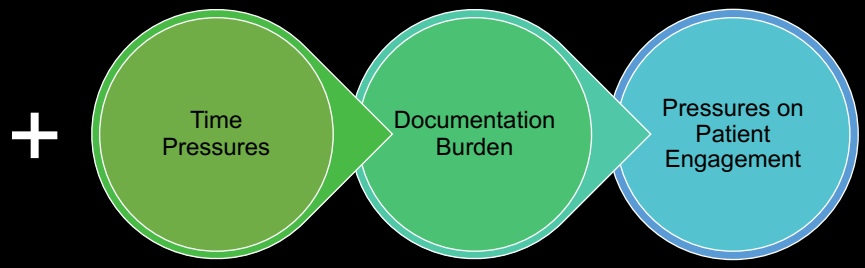
Additional Pressure on Patient Engagement



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Shortage of Physicians


China's doctor shortage prompts rush for AI health care

Credit: CC0 Public Domain

Qu Jianguo, 64, had a futuristic medical visit in Shanghai as he put his wrist through an automated pulse-taking machine and received the result within two minutes on a mobile phone—without a doctor present.


hindustantimes

Sunday, Oct 13, 2019

Healthcare crisis: Short of 5 lakh doctors, India has just 1 for 1,674 people

Millions cannot access India's overburdened hospitals and inadequate medical facilities, a crisis illustrated by the fact that India is short of nearly 500,000 doctors.

New Findings Confirm Predictions on Physician Shortage

APRIL 23, 2019

SHARE:

The United States will see a shortage of up to nearly 122,000 physicians by 2032 as demand for physicians continues to grow faster than supply, according to new data published today by the AAMC (Association of American Medical Colleges). The projected shortfall is similar to past projections and ranges from 46,900 to 121,900 physicians.

PRESS CONTACTS

Stuart Heiser, Sr. Media Relations Specialist

sheiser@aamc.org

202-828-0059

https://medicalxpress.com/news/2018-09-china-doctor-shortage-prompts-ai.html
https://www.aamc.org/news-insights/press-releases/new-findings-confirm-predictions-physician-shortage
https://www.hindustantimes.com/india-news/healthcare-crisis-short-of-5-lakh-doctors-india-has-just-1-for-1-674-people/story-SZenTvIJ78WtQVlo93tBVK.html

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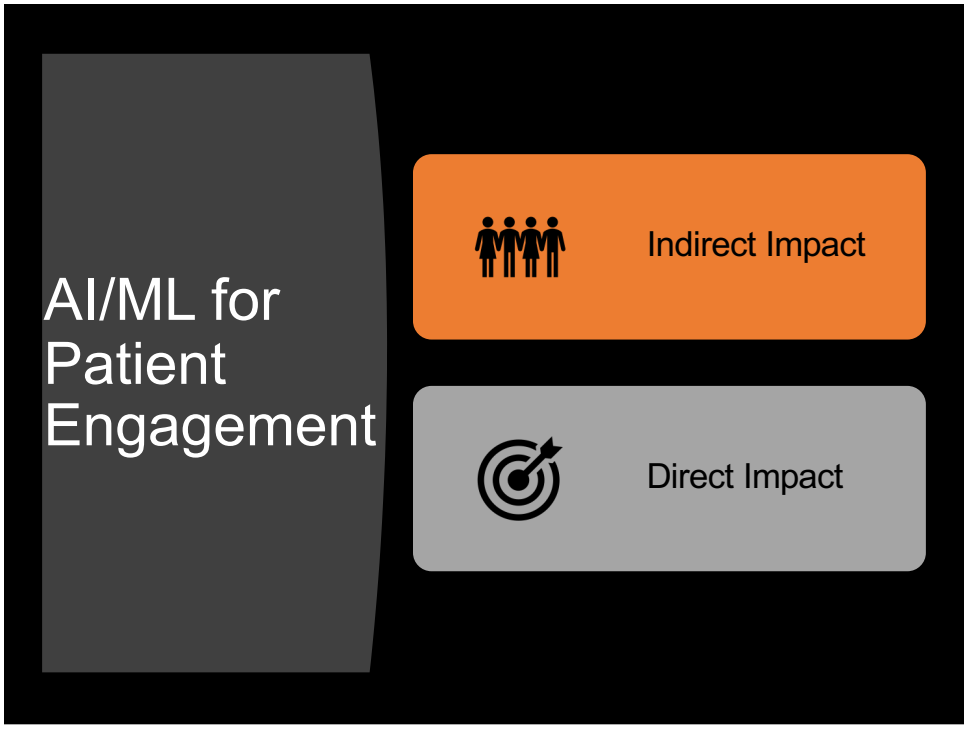

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Indirect Impact

- Timely right diagnosis and reduction of errors
  - Trust building and improved engagement
- Free the providers from 'mundane work'
  - Clinical Digital Assistant
    - AI and Voice Driven assistant for EHR and Exam Room workflow
    - Reduce time documenting notes
    - Allow clinicians to spend more time with patients
    - Allow better provider-patient interaction and engagement (the doctor will look at you now)
    - Focus on Patients not documentation
    - Reduce burn out
- Leverage Data Overload and Data Waste → Insights that were not obvious

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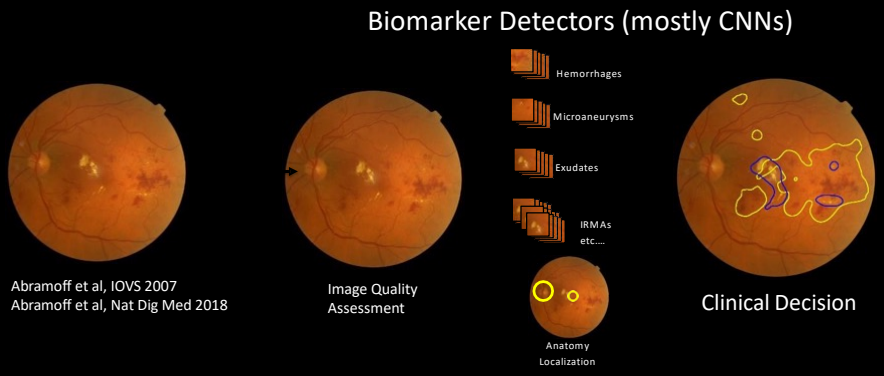
Helping Providers

IDx: Automatic Detection of Diabetic Retinopathy



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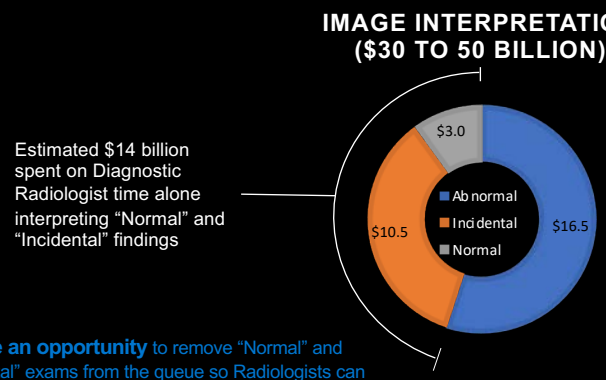
Helping Providers

Can we do the same for Radiology?



Is there an opportunity to remove "Normal" and "Incidental" exams from the queue so Radiologists can focus on reading complex "Abnormal" exams ?

Perhaps engage patients directly to explain the results?

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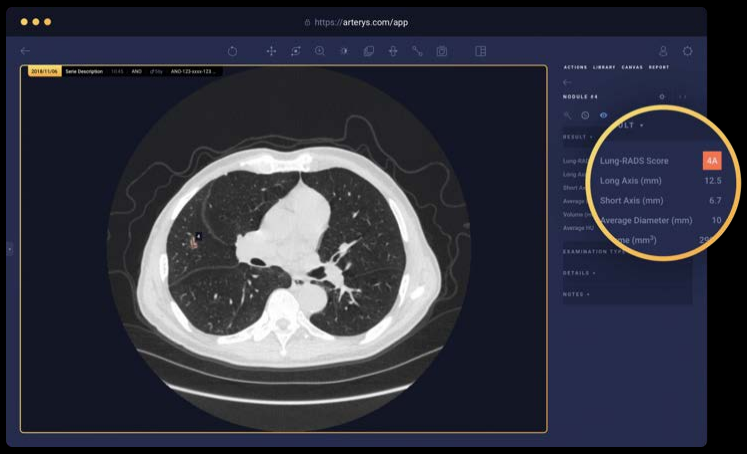
Helping Providers

Lung Cancer Screening (Arterys)



https://www.arterys.com/lung-ai/

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Triage Patients

High clinical acuity patients + **High** priority → Studies read **Fast**

Low clinical acuity patients + **Lower** priority → May take **Longer Time**

- Higher acuity patients hiding in the low clinical acuity setting

How do we help these patients?

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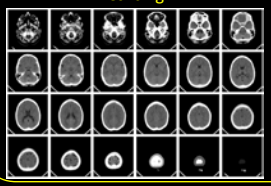
Helping Providers – Deeper Dive

Software and Hardware

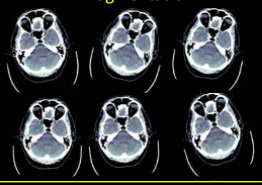
python™

Data Cleaning, QA and Preprocessing

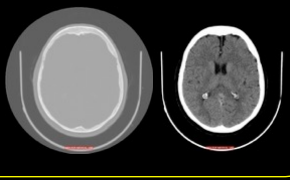
Reslicing



Augmentation



Contrast Adjustment



Training, Validation and Testing Datasets

Training Dataset	Testing and Validation Dataset	Augmented Training Dataset
37,084 (~80%)	9499 (~20%)	276,237

M Arbabshirani et al. *Nature Partner Journal: Digital Medicine.* 2018.

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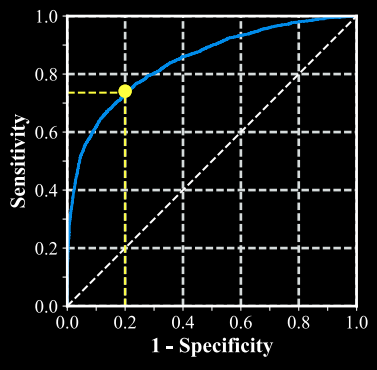
Results

- Good Performance: AUC = 0.85
- Chose balanced operating point (yellow circle)



M Arbabshirani et al. *Nature Partner Journal: Digital Medicine.* 2018.

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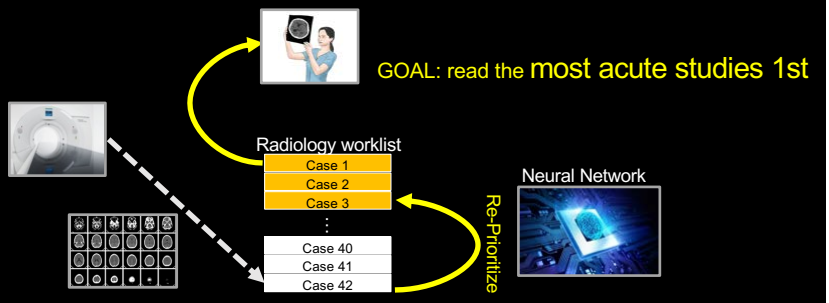
Worklist Reprioritization



M Arbabshirani et al. *Nature Partner Journal: Digital Medicine*. 2018.

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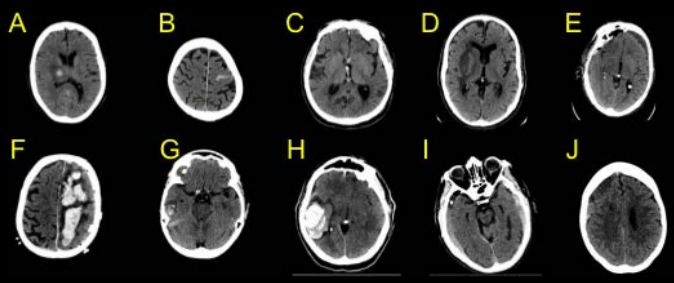
Types of Hemorrhages Detected

True Positive Cases



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Making a Difference

Clinical implementation of a machine learning algorithm reduced time to diagnosis of new outpatient cases of intracranial hemorrhage by 96%

Approximately 10% of “false positives” - subtle hemorrhage?

M Arbabshirani et al. *Nature Partner Journal: Digital Medicine*. 2018.

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Direct Impact - Nonclinical

Predicting Denials

Predict no-shows and cancellations

Determine the appropriate appointment length

https://www.healthcarefinancenews.com/news/why-hospital-revenue-cycle-practically-begging-artificial-intelligence-and-machine-learning

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Direct Impact - Clinical

- Engaging Patients to Address Care Gaps
  - AAA
    - Machine NLP 'reads' Radiology Reports → Find patients who are at risk and have a care gap → Work with Primary care providers to engage the patient and start appropriate treatment pathway
  - Colon cancer screening
    - Can we use existing data (CBC, age, gender, etc.) to risk stratify patients?
    - Yes
  - Finer Points of Lung Cancer Screening
    - NLCS (National Lung Cancer Screening) trial – broad strokes recommendations
    - Can we have more granular recommendations?

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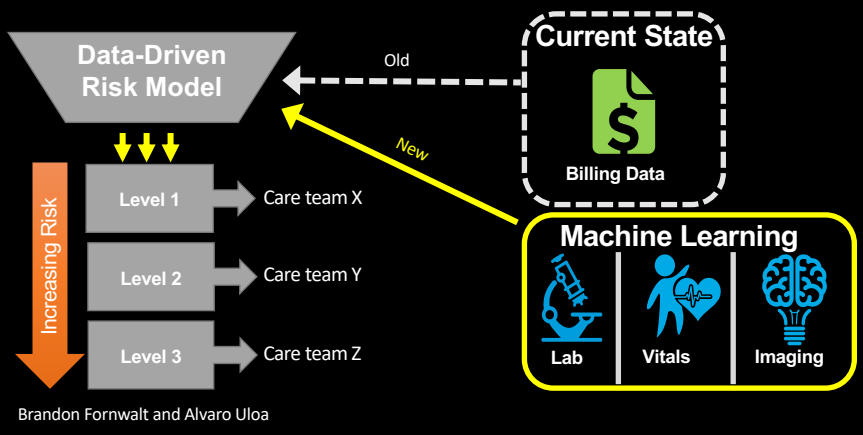
Direct Impact – Risk Stratification



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Helping Providers Engage Patients

ECG for survival and atrial fibrillation prediction

- Is there a 'signal' in 'normal' ECG's to predict future events?
  - Brandon Fornwalt, Sushravya Raghunath
  - Recent Paper in Lancet by Attia et al.

EMR data for stroke prediction

- Can laboratory and EMR data predict risk of a stroke ?
- Allows identification of the most important modifiable factors driving the risk, allowing intervention to reduce the risk
- Limited Trial starting in November
  - Clemens Schirmer, Dhruv Mathrawala

Attia ZI, Noseworthy PA, Lopez-Jimenez F, Asirvatham SJ, Deshmukh AJ, Gersh BJ, et al. An artificial intelligence-enabled ECG algorithm for the identification of patients with atrial fibrillation during sinus rhythm: a retrospective analysis of outcome prediction. Lancet. 2019; pii: S0140-6736(19)31721-0.

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Summary

- AI and ML have a definite role in improving Patient Engagement by either
  - Indirect impact
  - Direct impact

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