Caring

Geisinger

Application of AI in Healthcare

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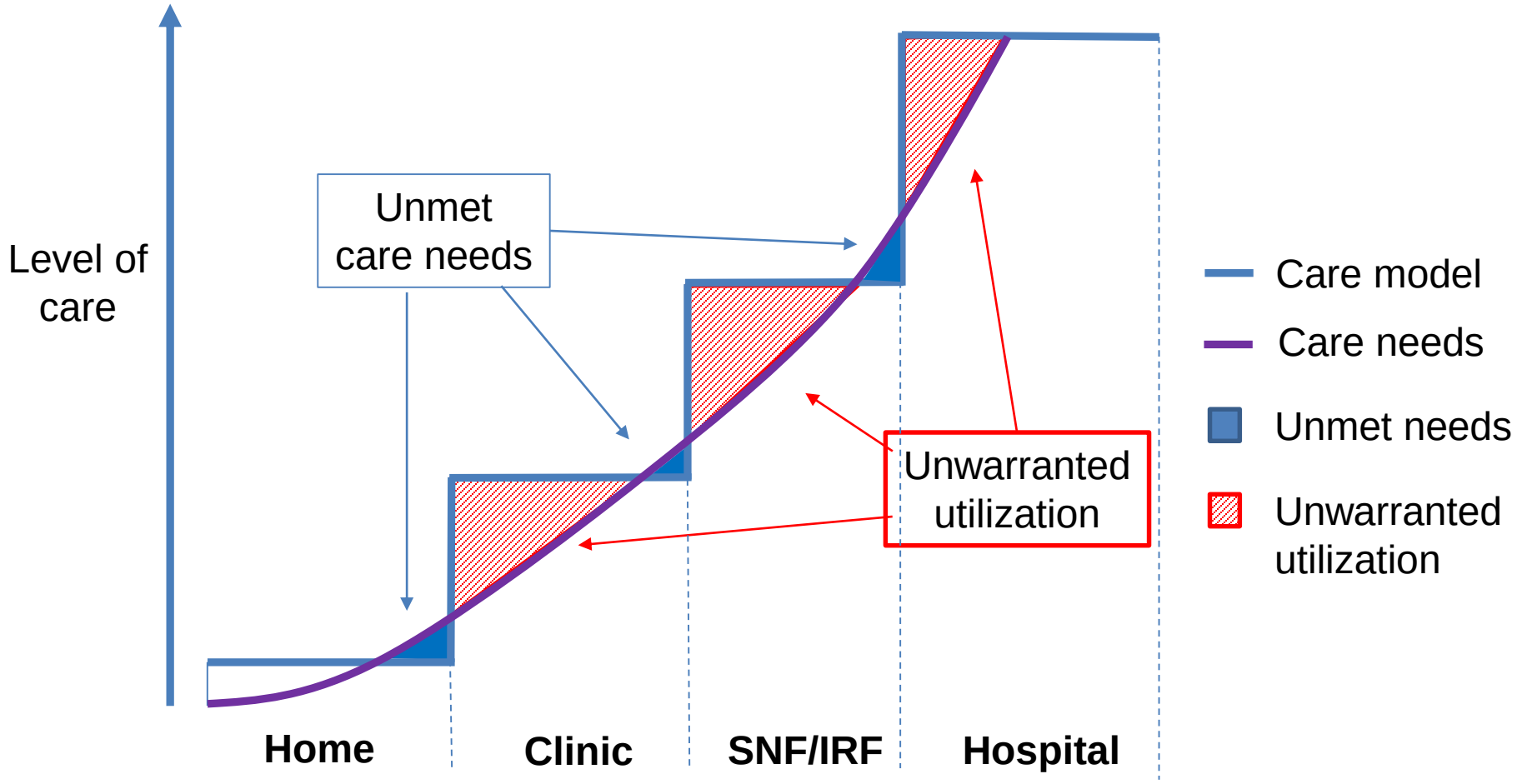
Overview

- Why AI in Healthcare topic matters
- Is AI just another shiny objects?
- Geisinger AI collaborations
- Categories of “AI”
- Geisinger context (Innovation, UDA, DML)
- Considerations for talent acquisition
- Experience performing AI
- Issues encountered with AI

Care model does not match patient care needs



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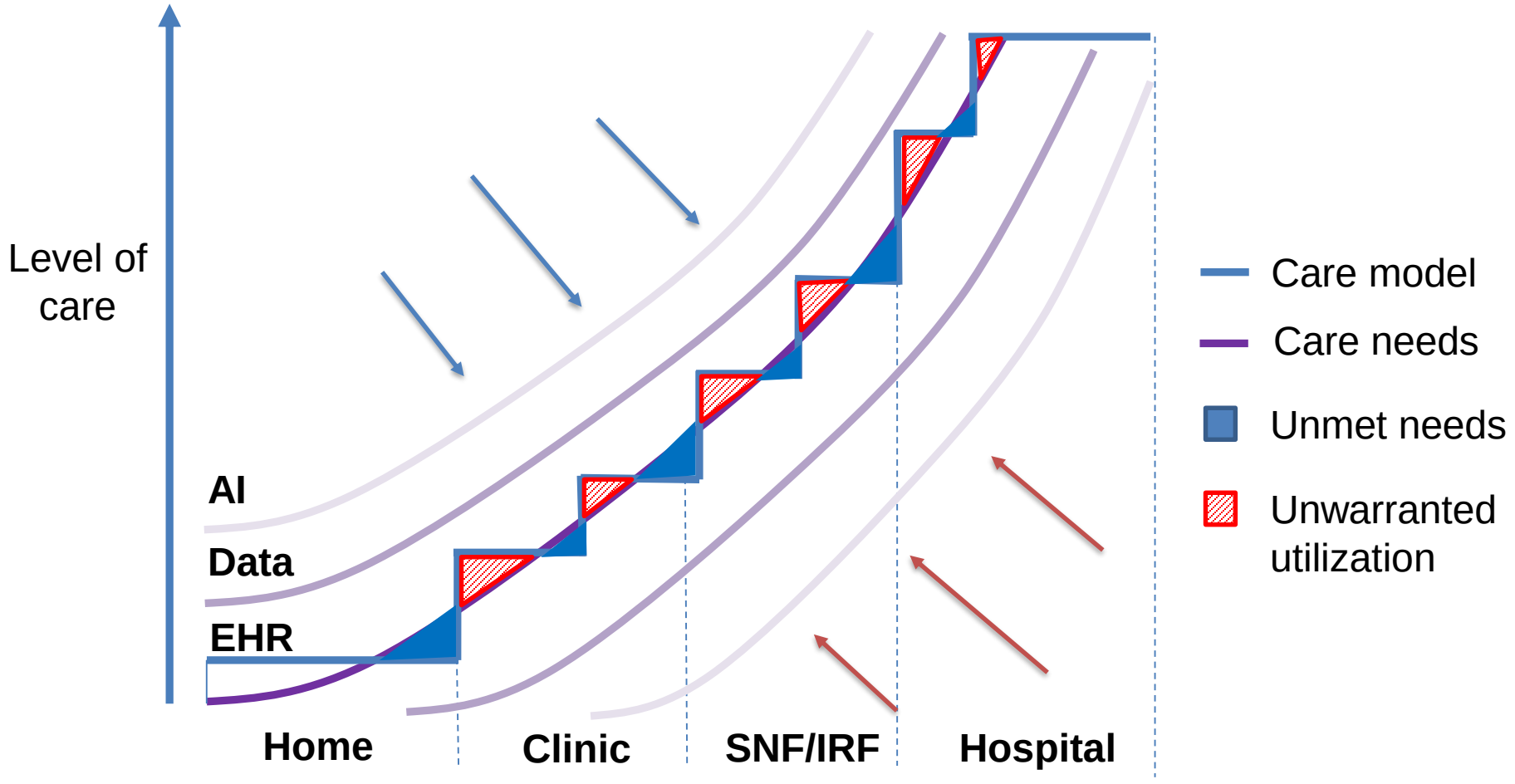
EHR, data and AI help match patient needs



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“Green Button” (ad-hoc EHR queries)

RCT generate ***evidence-based medicine***; however, they

- take time and are costly
- narrow inclusion criteria

EHR could generate ***practice-based evidence***

- by-product of clinical processes
- integrating point-of-care randomization into practice
- Fill gap in knowledge when EBM does not exist

Longhurst CA et al, Green Button for using aggregate Patient Data at the point of care, Health Affairs 2014, 33 No 7, 1229-1235

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AMA weighs in on AI "Augmented Intelligence"

"Combining ***AI methods*** and systems with an ***irreplaceable human clinician*** can advance the delivery of care in a way that outperforms what *either can do alone*."

"But we must forthrightly address challenges in the ***design, evaluation and implementation*** as this technology is increasingly integrated into physicians' delivery of care to patients."

Jesse M. Ehrenfeld, M.D. M.P.H.

AMA Board Member

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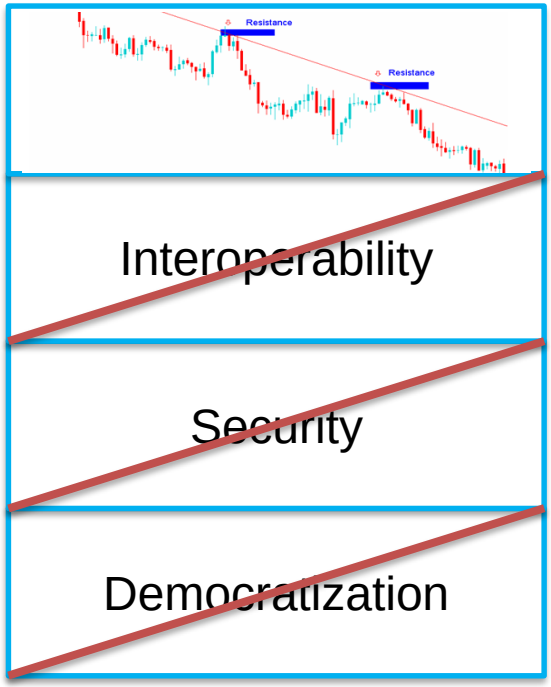
Is AI just another shiny object?

BLOCKCHAIN



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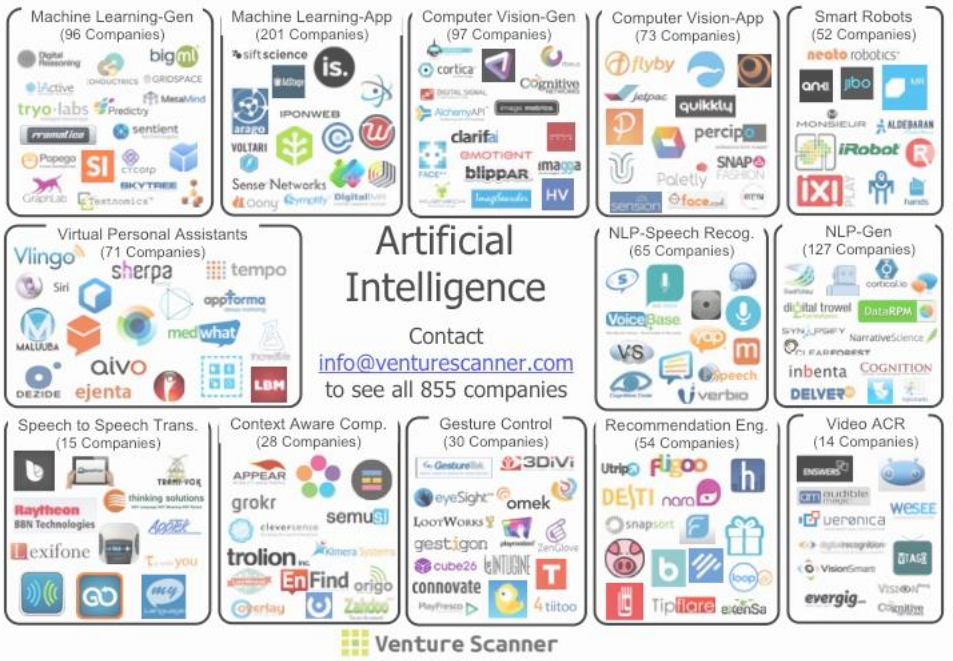
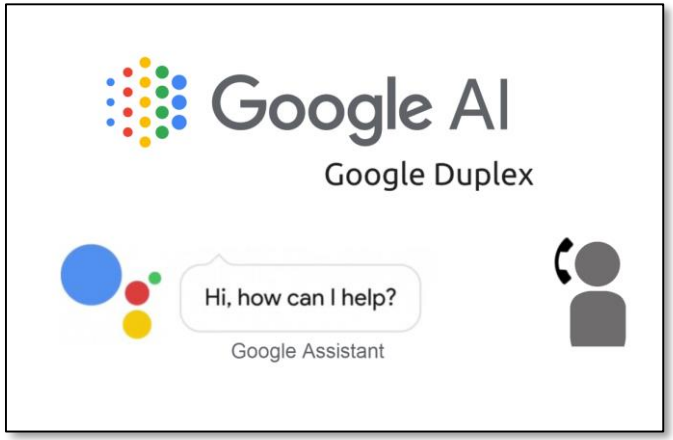
No want for AI in the media

Plenty of options



Plenty of drama



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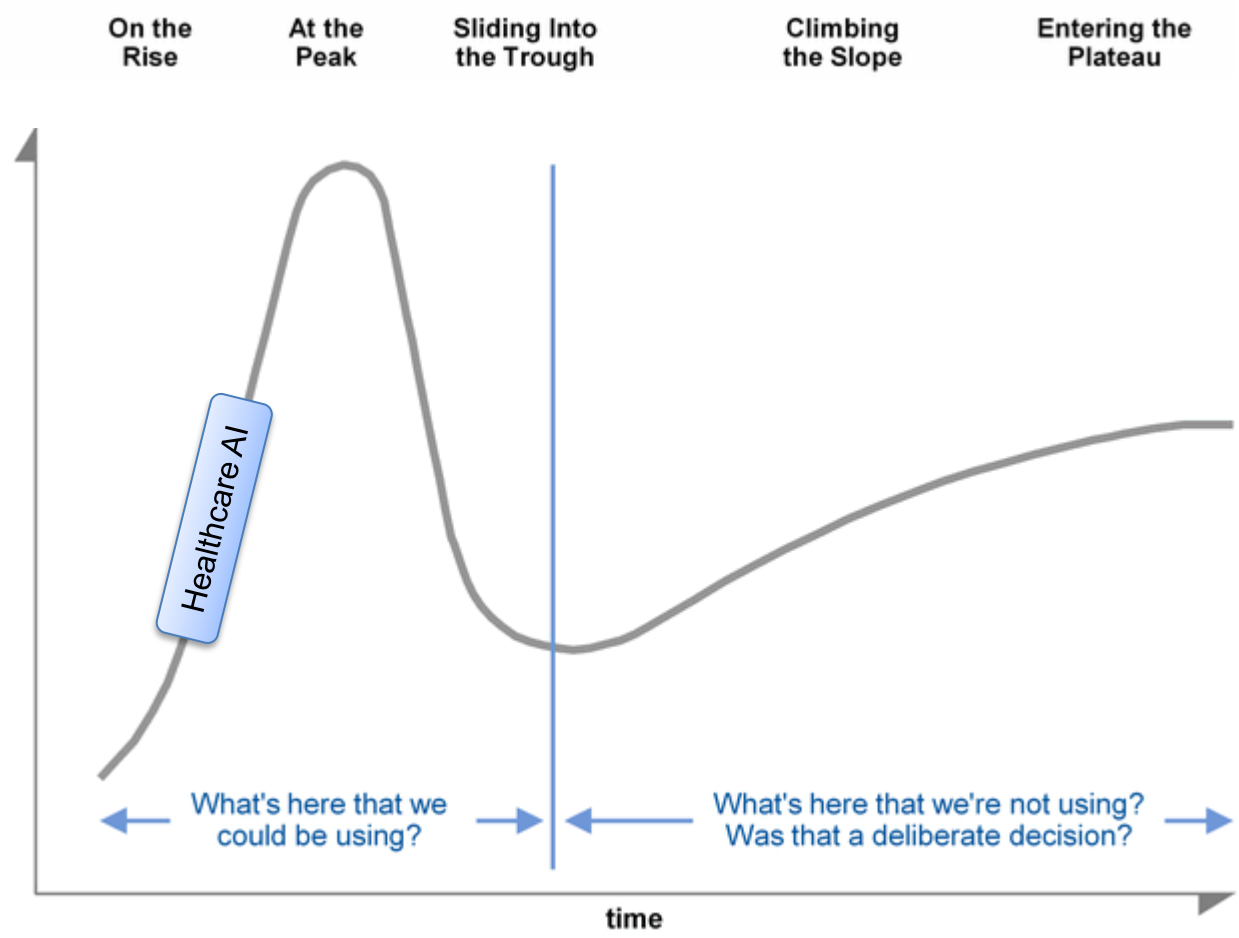
Gartner Hype Cycle – healthcare AI?



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Source: Gartner Hype Cycles

Geisinger has selected a sample of partners

Massachusetts Institute of Technology

Cancer, **Sepsis**
ACS, CHF
Stroke, Data Imputation

CROSSCHX

Patient access, HEDIS,
test follow up, **Sepsis**,
risk population

Medial EarlySign

AlgoMarkers
Colon Cancer screening
Sepsis surveillance

jvion

C. Diff tracking
COPD admission and
re-admission

Under NDA

Cool stuff…

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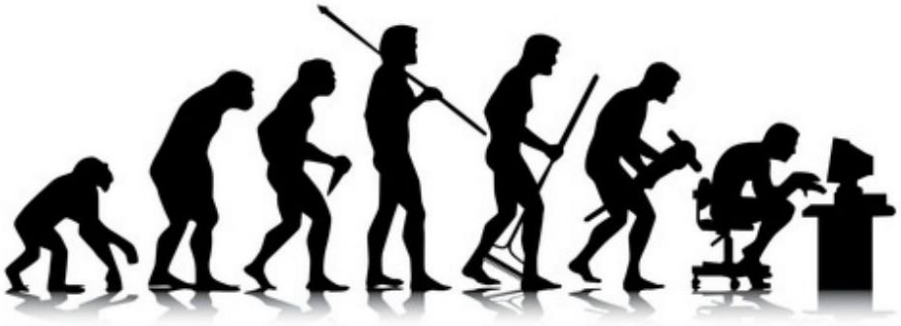
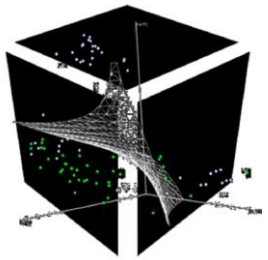
What is “AI” vs “ML” vs “DML”





Human Intelligence	Artificial Intelligence	Machine Learning	Deep Machine Learning
Evolution	Computers Mimic Humans	Stats to improve performance	Multidimensional scale (some degree of unsupervised)

Interpretability

accuracy

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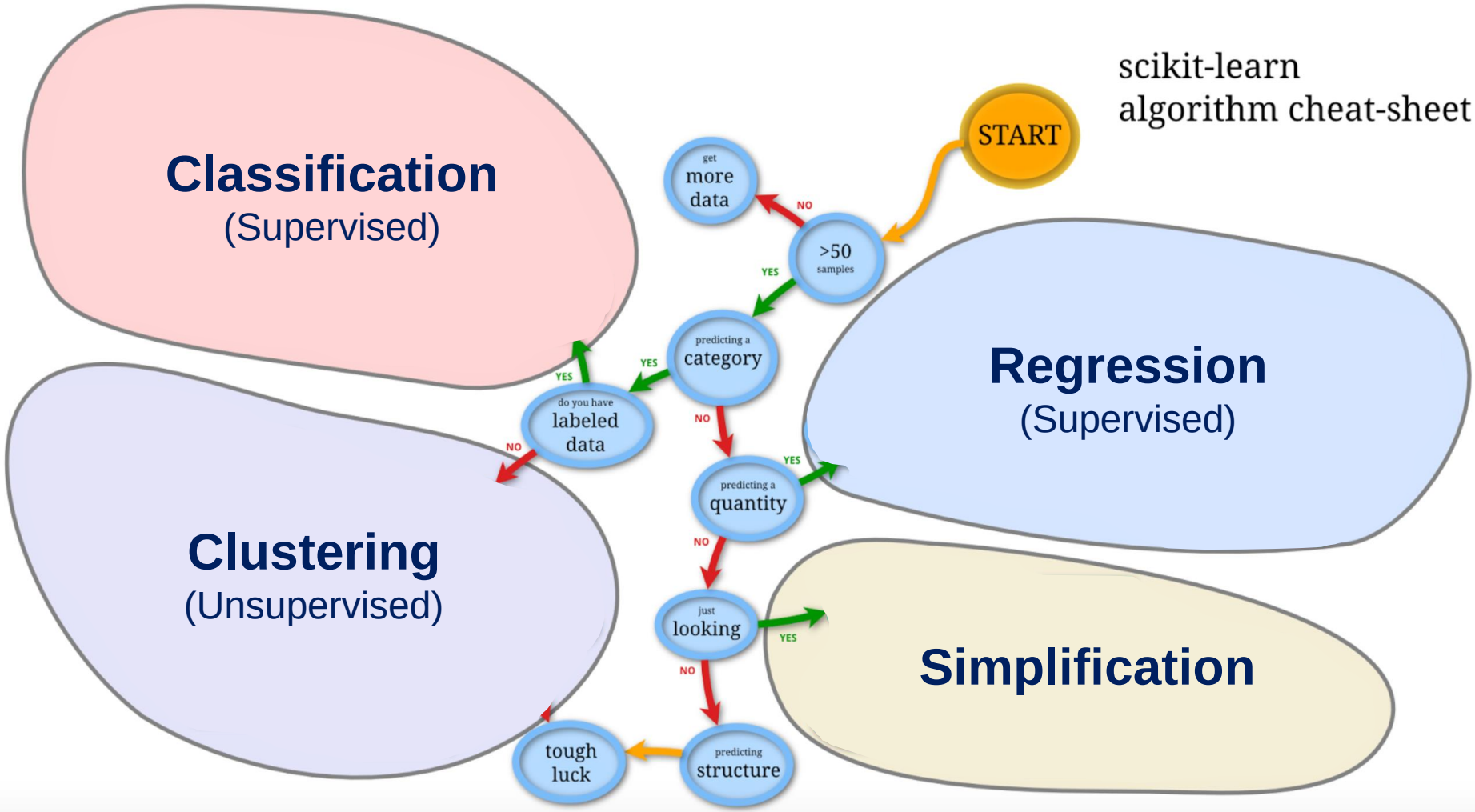
Categorizing AI - Not all AI is created equal



Courtesy Andy Mueller located here

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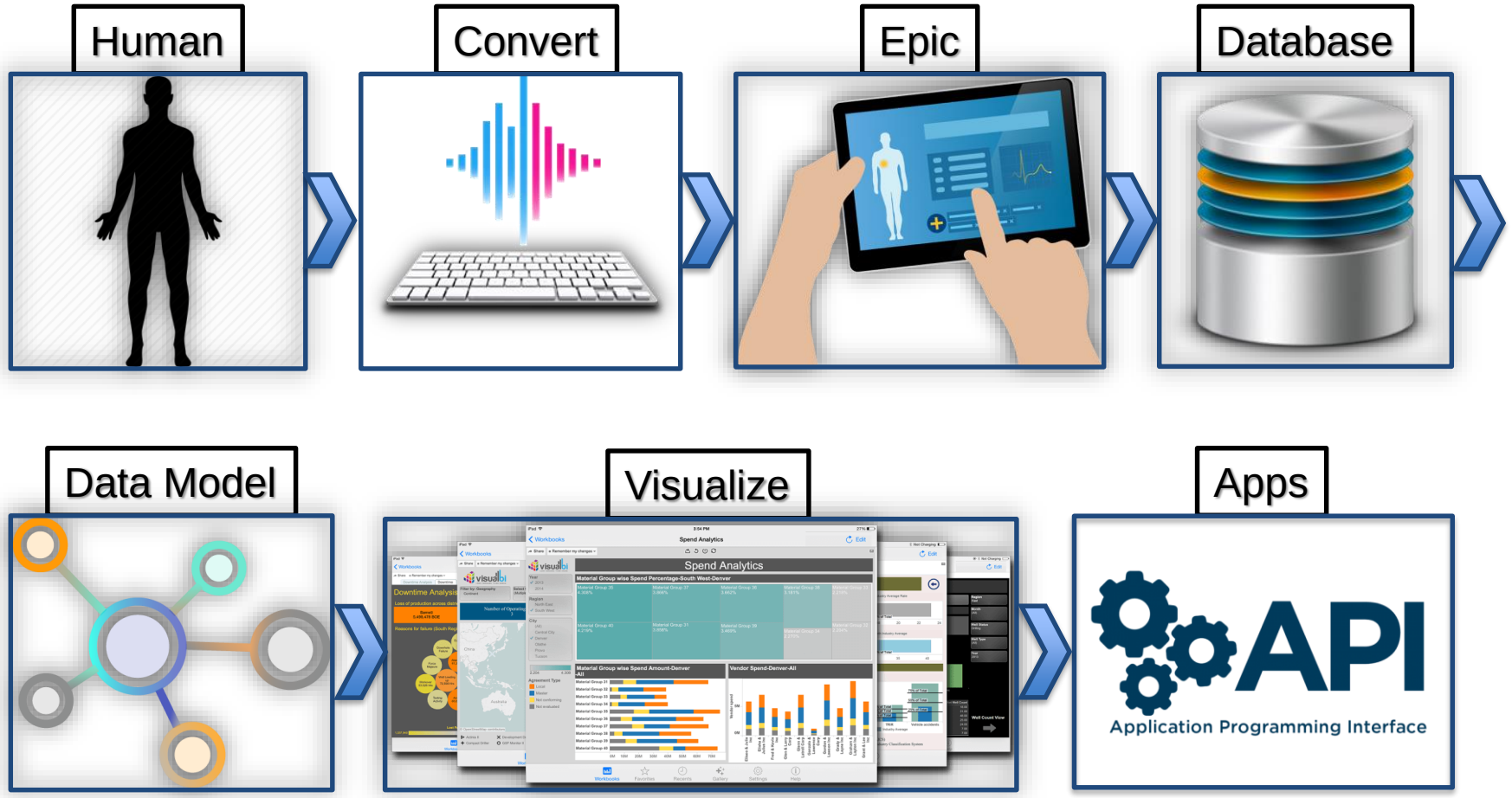
Geisinger: Following the Datum



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By the numbers

55 Data Sources

Sources Live

EHR (Epic)
Longitudinal record (Cerner)
Genomics (Regeneron)
Health Plan Claims (Trizetto)
Radiology (PACS, Speech)
Cardiology (EKG, Echo)
Oncology (Oncolog)
Pathology (Copath)
Pulmonary (Breezesuite)
Lab (Sunquest)
Health Exchange (KeyHIE)
Patient survey (DataStat)
Secure text (TigerText)
Real time tracking (Teletrack)

4.4M Million

Unique patients on platform

595k Health Plan member
22,900 Active Providers
1M Surgical cases
198M Encounters
300M Clinical notes
4M Pathology specimens
2.4M Patient billed
89M Encounters billed
75.4M Health Plan claims

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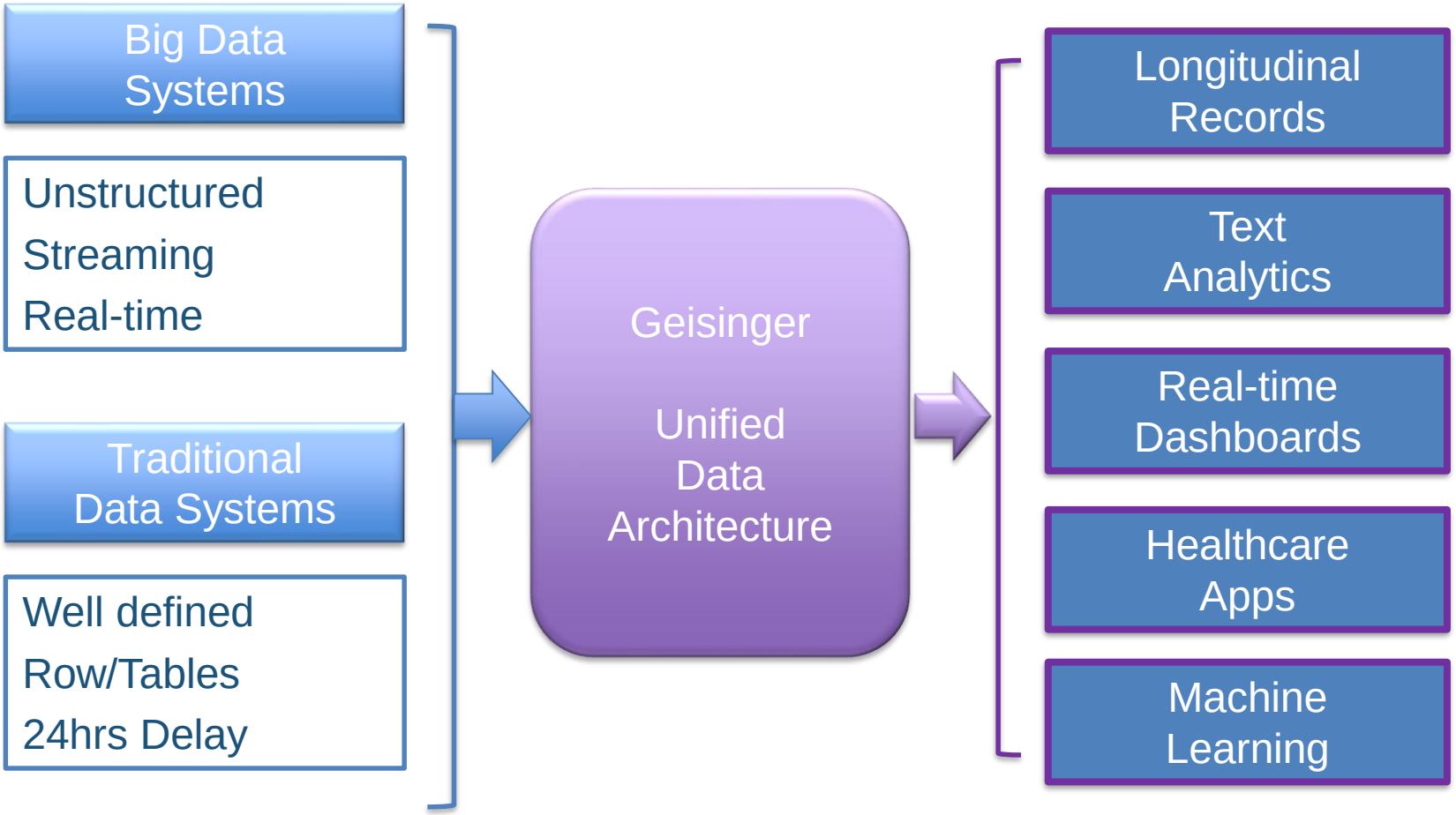
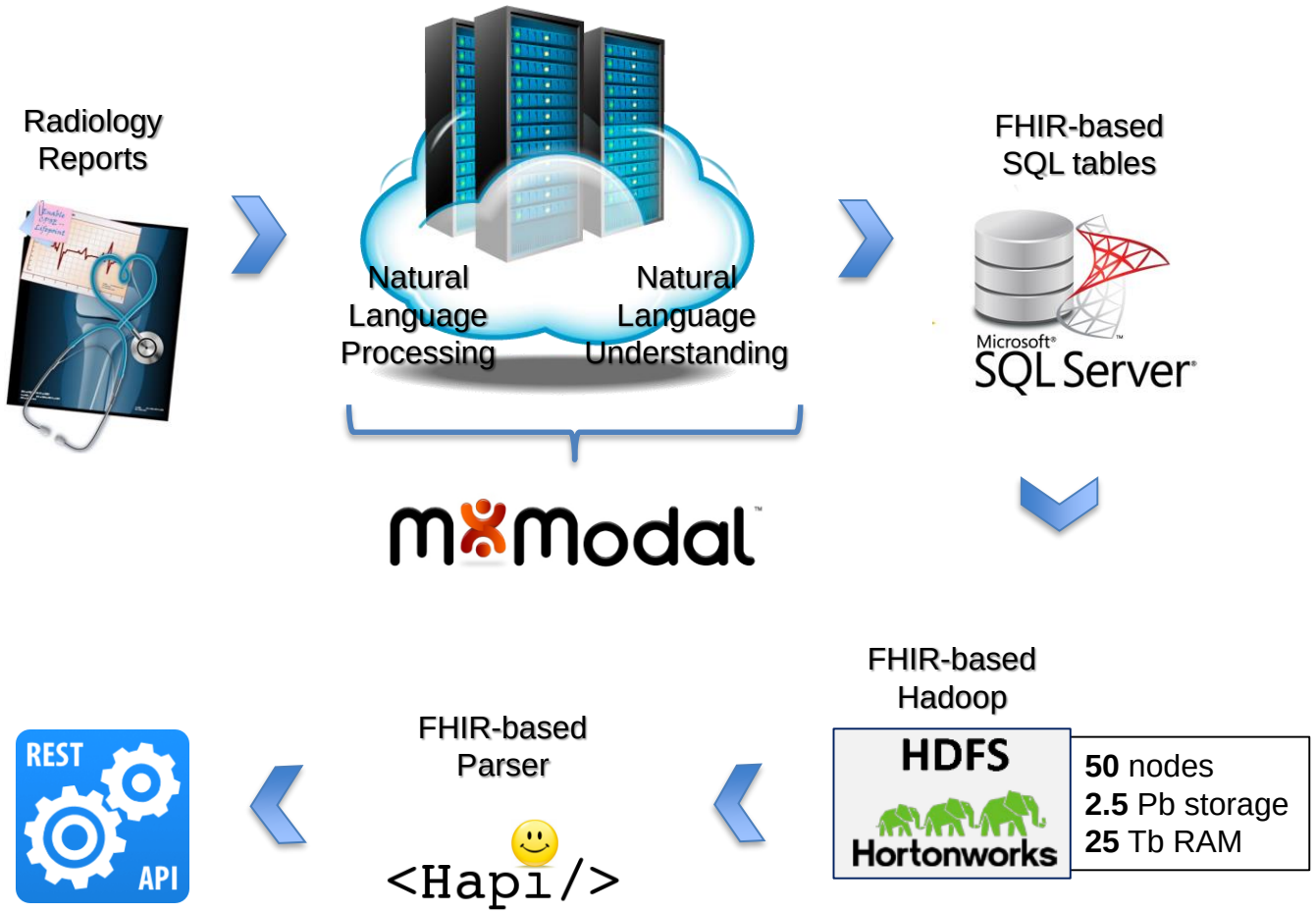
Geisinger Unified Data Architecture



API: Hadoop on FHIR



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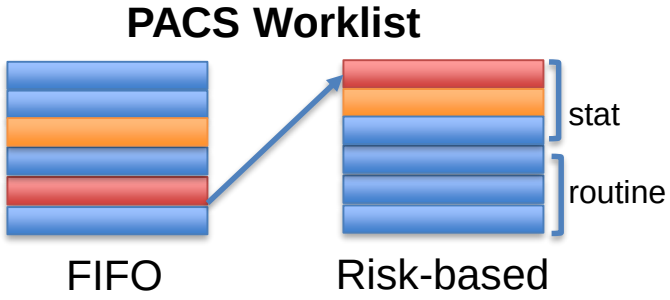
DML: Imaging classification



Problem: Needed to improve the timeliness ICH assessment for clinic patients without solely relying on the ordering physician priority designation.

Approach: 46,583 head CTs (~2 million images) acquired from 2007–2017 were collected from several facilities across Geisinger. A deep convolutional neural network was trained on 37,074 studies [training set] and subsequently evaluated on 9499 unseen studies [testing set]. The predictive model was implemented prospectively for 3 months to re-prioritize head CTs at high risk of ICH.

Results: The model achieved an area under the **ROC curve of 0.85**.

- 94 of 347 (27%) “routine” studies were re-prioritized to “stat”
- 60 of 94 (63%) had ICH identified by the radiologist
- **5 new cases of ICH** were identified
- Median time to diagnosis was reduced ($p < 0.0001$) from 512 to 19 min.

Arbabshirani et al, *npj Digital Medicine* **volume 1**, Article number: 9 (2018)

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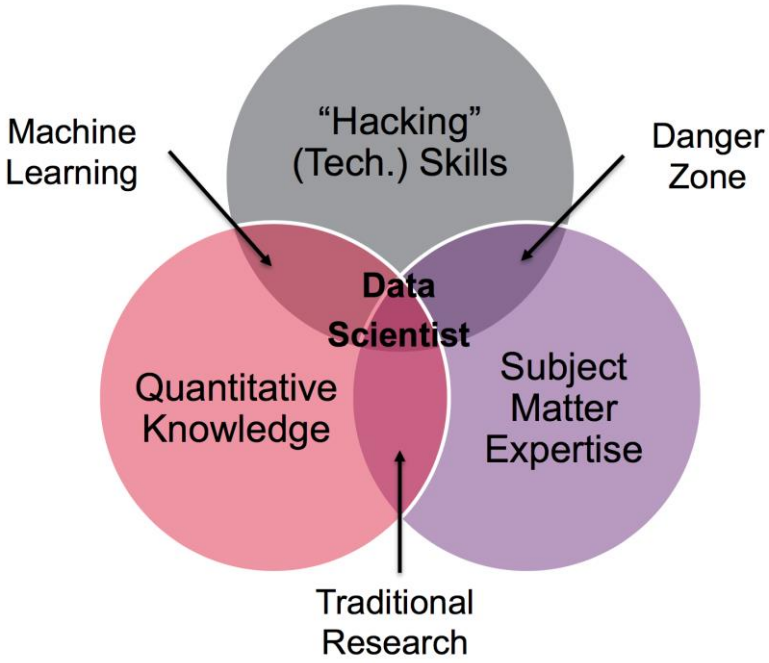
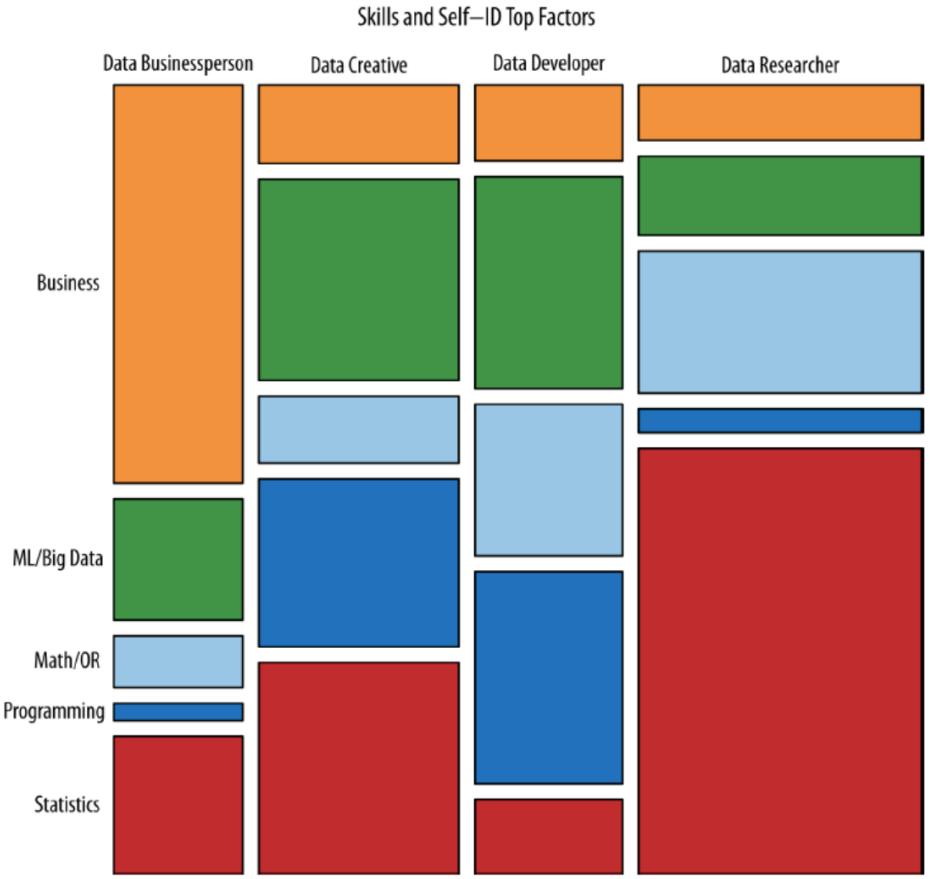
Talent acquisition – DNA of Data Scientist



Source: Drew Conway



Source: O'Reilly

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Stroke AI – sample effort

Hypothesis
We hypothesize that with the plethora of variables, we will be able to determine which will place patient/members at risk of developing stroke within 12-month.

Objective
The primary objective of this AI analysis is to predict with better accuracy and more precision which patients will develop a stroke within 12-months

Results
Using a limited portion of the overall Geisinger dataset, we were still able to find statistical significant features in the prediction of stroke 12-month before an event. Heart Rate played an important role (not in existing predictor)

Insight
The vast majority of the time spent was on data preparation, not “AI”

Regression and Classification

Current feature Groups (Data Types) and features(Data variables)

- **Demographics:** Gender, Race, Age
- **Vitals:** BP measures, HDL value, Cholesterol value, smoking status, BP treatment status, Diabetes status

Aggregation methods for features (Feature Construction from Longitudinal EHR Patient Data)

- Age (use the latest value at the time of prediction),
- Race and gender are static
- For BP, HDL, Cholesterol use the mean value over the chosen observation period
- For smoking status, BP treatment status and diabetes status, use the percentage of observation time under treatment

Supervised ML predictor

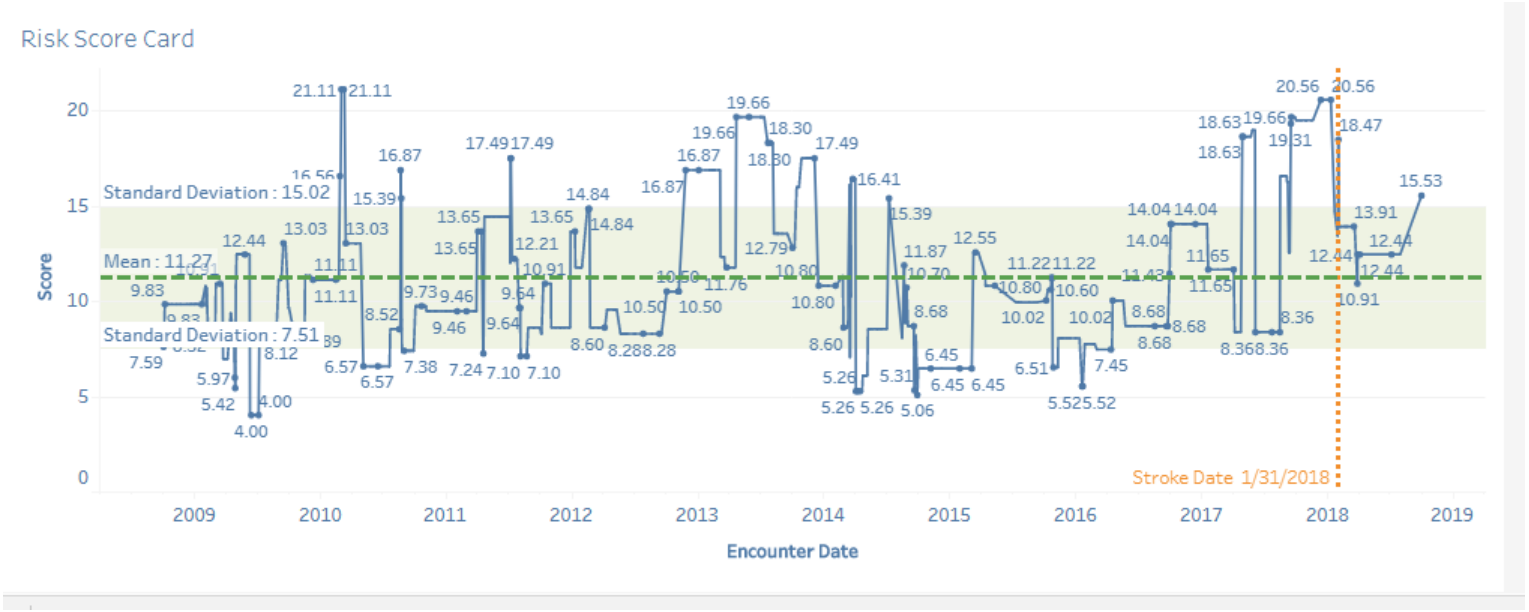
- L1-regularized Logistic Regression
- Random Forest Classification

Model Features

Considered 800k patients with 10k features, but simplified. Focused on variables considered to derive the ASCVD score (9 variables)

Age, Gender, Race, HDL, Total Cholesterol, Systolic BP, Diabetes, Smoking status, Treatment status for High Blood Pressure

Total number of encounters – 98,924



Courtesy: Clemens Schirmer

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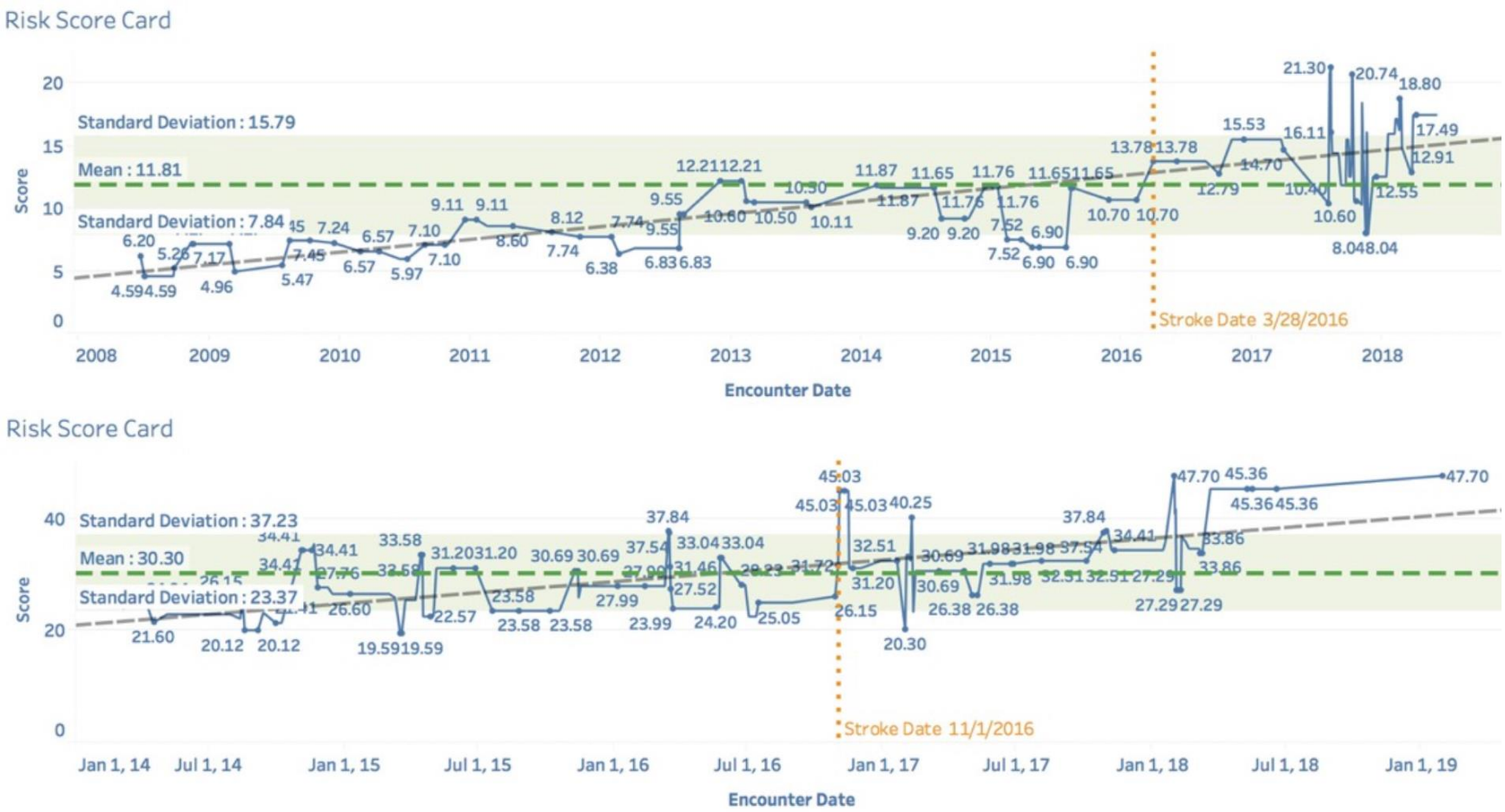
Clinical failures?



Courtesy: Clemens Schirmer

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Risk score card (after applying statistical smoothening technique)

- Normalized time to stroke event
- observed trends over time,
- comparison between stroke patients

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Future Enhancements

- Automate the process to calculate the risk score after each encounter.
- Include all of the Geisinger patients.
- Add additional relevant features (SDOH, Genomics, etc.)
- Derive additional insights by applying advanced classification techniques, using unsupervised ML approaches.
- Build Machine learning models to predict the stroke events.

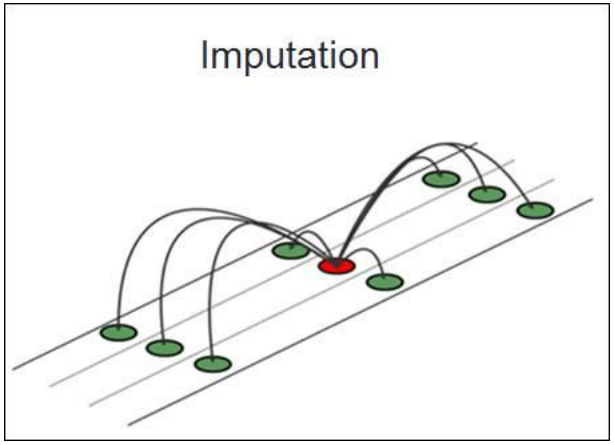
Key point: vast majority of the time working with “AI” is spent on data management not machine learning.

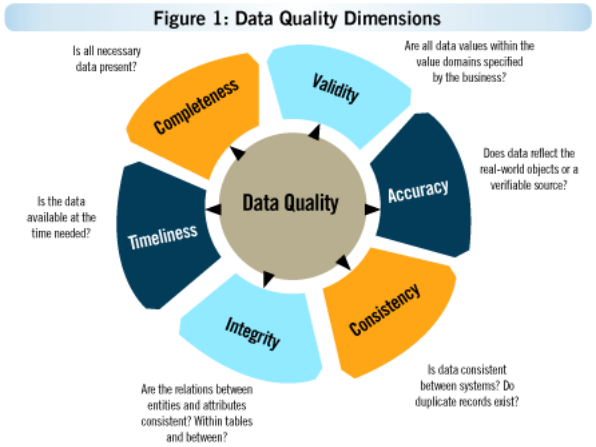
Issues when performing AI work

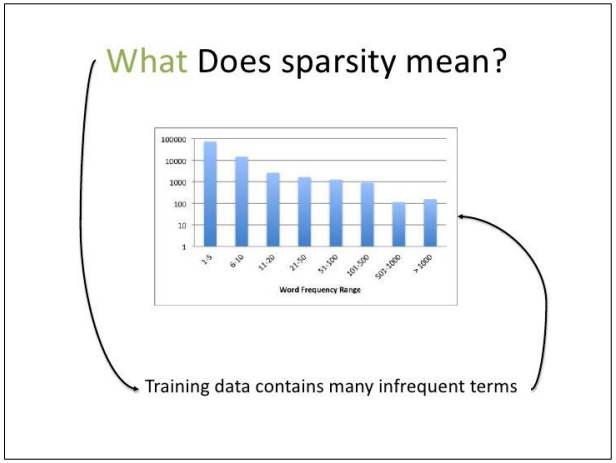
IRB
Institutional Review Board

vs

HIPAA
Health Insurance Portability & Accountability Act







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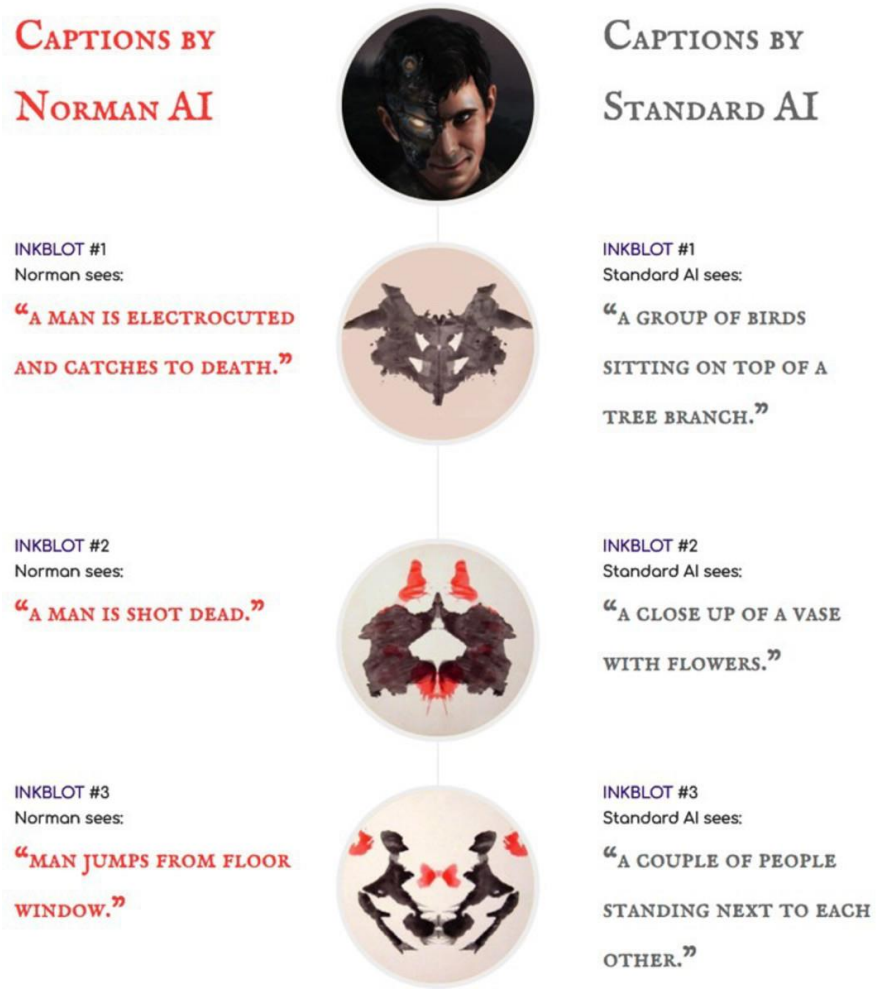
Data ethics and bias – meet Norman



Source:
MIT Media Lab

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Introducing

Dr Ben Hohmuth

Geisinger's new **CMIO**

Contact Dr Karen Murphy
kmurphy2@geisinger.edu

Chief Data Scientist

Care delivery **Economics** **Environment** **Health** **Payment**

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