Crossing the ‘AI chasm’: moving from research into the clinic

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Disclosures

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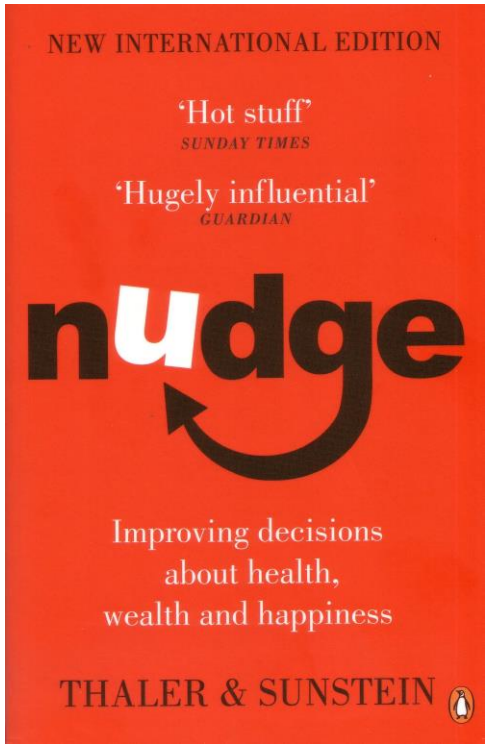
How can we improve patient safety and care quality?

My ‘eureka’ moments

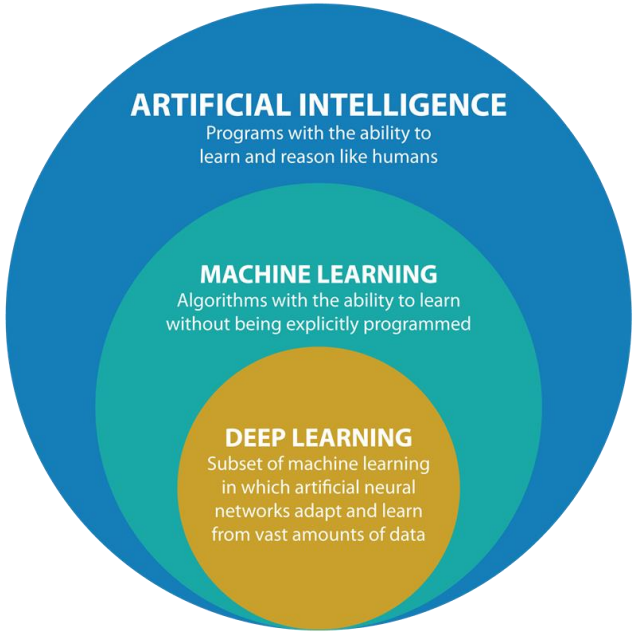
Behavioral sciences

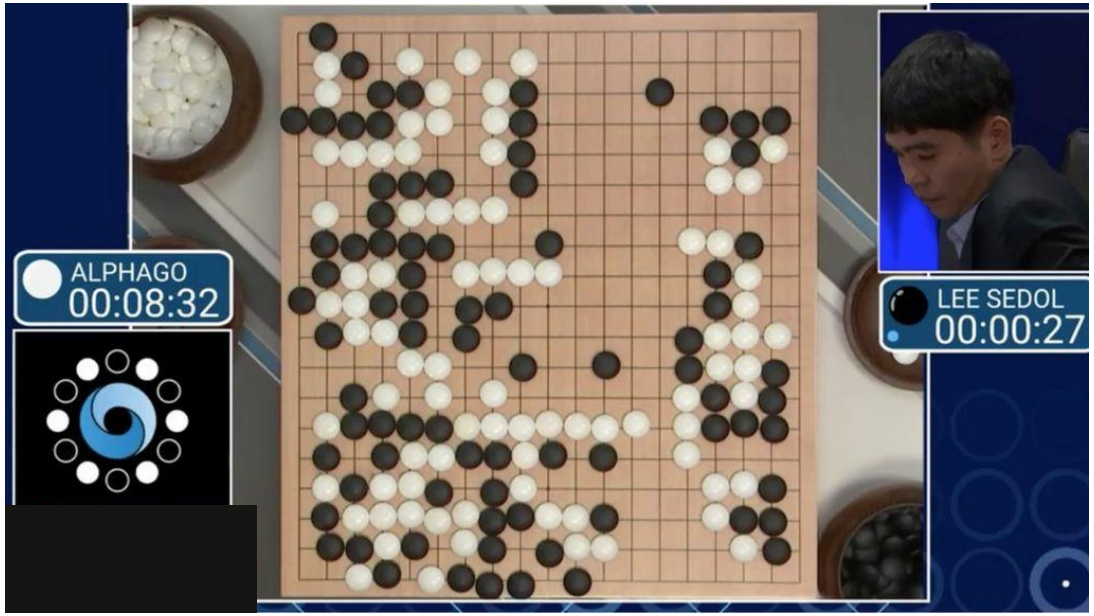


Digital health

Artificial intelligence

Deep learning revolution





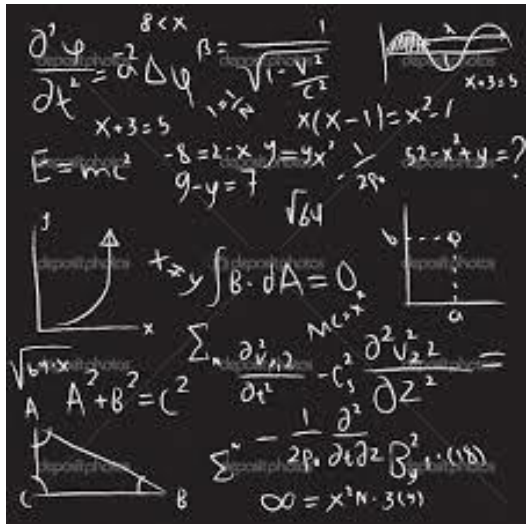
Nature, BBC

In last decade, different forces powering AI systems have converged

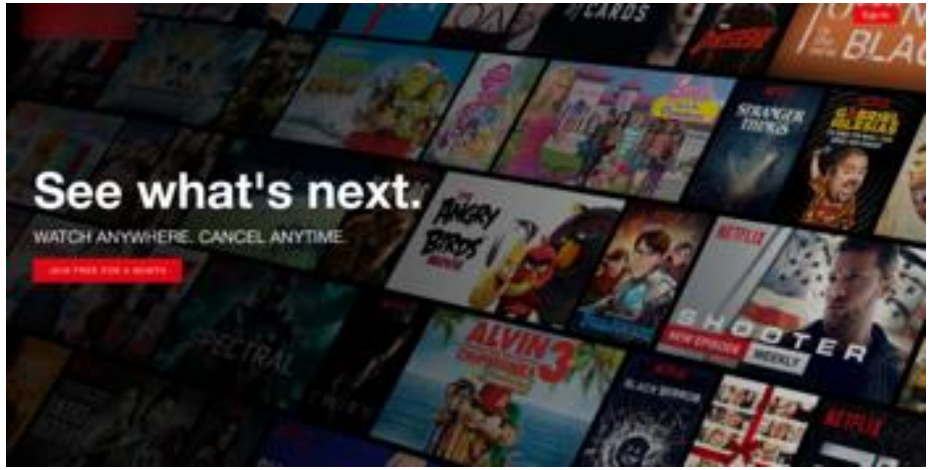
Big data

Enhanced computing power

Better algorithms

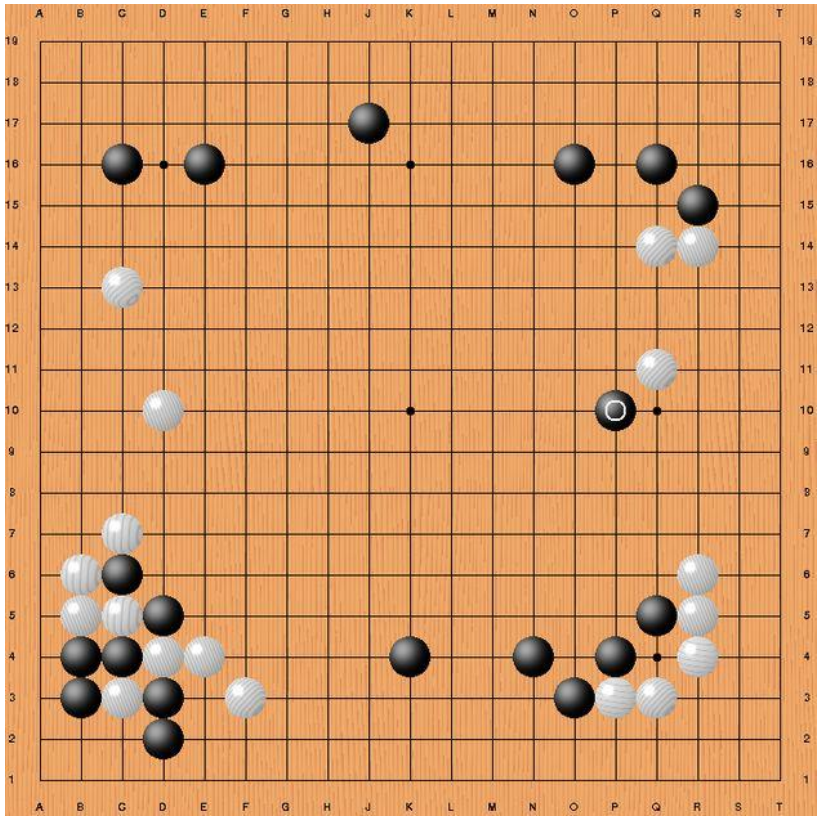


Translating AI into production systems



The power of human + machine

Deep Blue and AlphaGo made humans better players, can AI have the same impact in healthcare?



Applying AI technology to healthcare challenges

Basic science	**Discovering new mechanisms for diagnosing and treating disease** • Genomics • Protein folding and drug discovery
Clinicians	**Improve workflows and reducing medical errors** • Diagnostics and image interpretation – scans, pathology slides, ECGs, endoscopy • Up-level generalists with AI powered superpowers to confidently manage a greater range of complex disease
Consumers	**Enable people to look after their own health needs** • Tracking including behavioral health • At home health screening (e.g., atrial fibrillation)
Health systems	**Better manage scare resources, identify patients at risk** • Identify those at risks of (re)admission • Reduce administrative complexity

Medical imaging: ophthalmology

Clinically applicable deep learning for diagnosis and referral in retinal disease. *Nature Medicine*

Problem

- Number of Americans with blindness or severe visual impairment set to double by 2050
- Eye imaging is becoming more complex and challenging to interpret

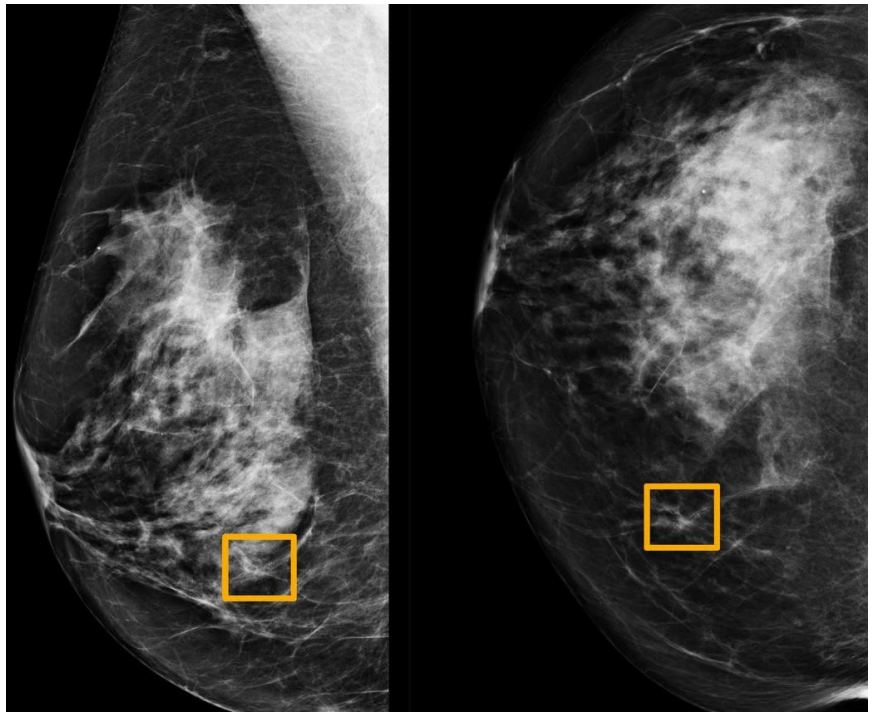
Results

- Detection – able to detect dozens of eye conditions from OCT (3D eye scans) at level of world's leading experts
- Prediction - In patients diagnosed with AMD in one eye, AI system predicts progression in second eye within a clinically actionable 6-month time window overcoming substantial interobserver variability

Nature Magazine, 2018 and 2020

Health screening: breast cancer

International evaluation of an AI system for breast cancer screening. *Nature*



Problem

- Interpretation of mammograms is affected by high rates of false alarms and missed cases
- In many countries not enough radiologists to read images in a timely way particularly where 2 readers are used

Results

- False positive reduction – 5.7% (US) and 1.2% (UK)
- False negative reduction – 9.4% (US) and 2.7% (UK)
- Outperformed all human readers by an absolute margin of 11.5%
- AI system able to generalize from UK to US
- In simulated study able to reduce workload of 2nd reader by 88%

Nature 2020

Electronic health record predictions: patient deterioration

A clinically applicable approach to continuous prediction of future acute kidney injury. *Nature*

Problem

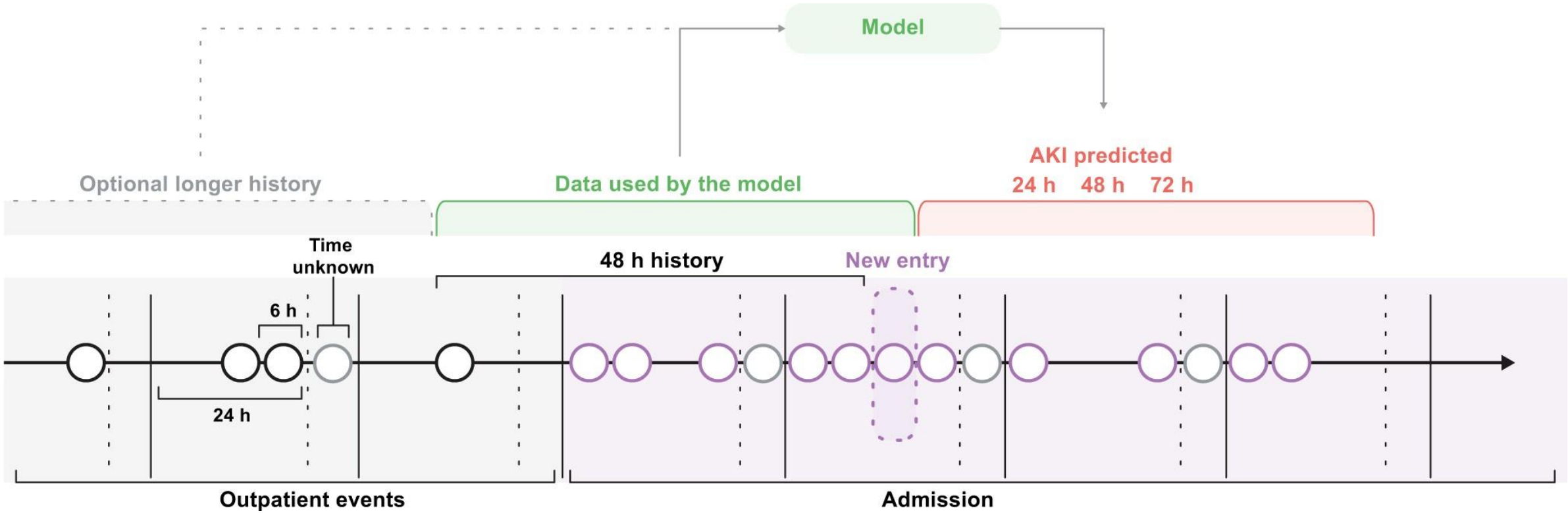
- 11% of deaths in hospital follow a failure to promptly recognize and treat deteriorating patients
- Opportunity to enable earlier treatment if able to identify patients at risk of conditions like sepsis and acute kidney injury

Results

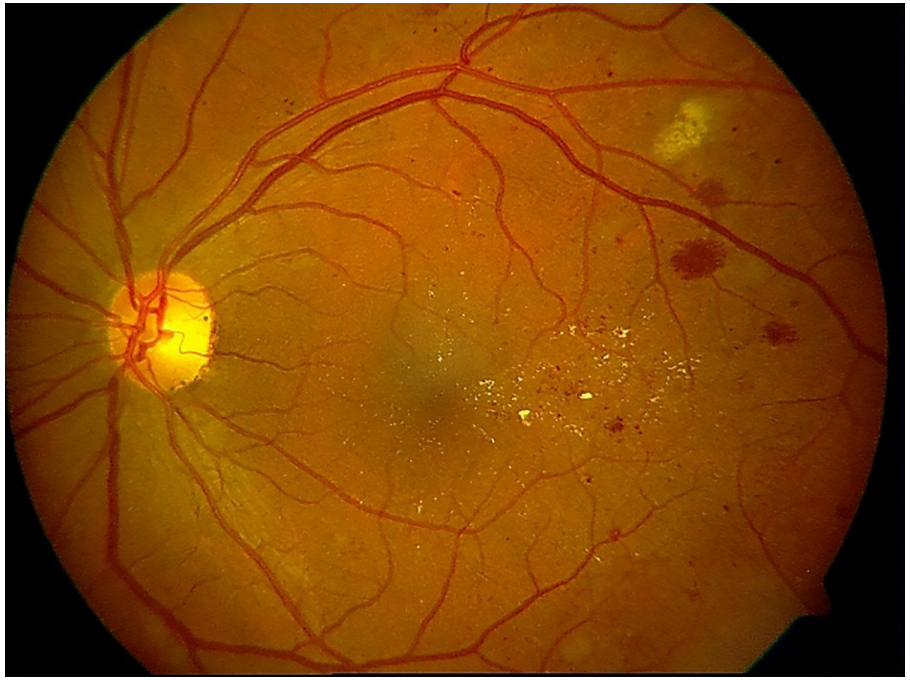
- >700k patients across 170 inpatient and 1000 outpatient VA sites
- Able to predict 90% of all patients subsequently requiring dialysis up to 48 hours before
- Provides confidence assessments and a list of clinical features most salient to each prediction

Nature 2019

Extensible to health predictions outside of the home



From expert performance to identifying novel signals of disease



Article | Published: 19 February 2018

Prediction of cardiovascular risk factors from retinal fundus photographs via deep learning

Multicenter Study > Lancet Digit Health. 2020 Jul;2(7):e358-e367.
doi: 10.1016/S2589-7500(20)30108-4. Epub 2020 Jun 23.

A deep learning algorithm to detect anaemia with ECGs: a retrospective, multicentre study

In the last 5 years, lots of research papers have been published

Original Research | September 18, 2018

Real-Time Use of Artificial Intelligence in Identification of Diminutive Polyps During Colonoscopy

ORIGINAL ARTICLES

Impact of Deep Learning Assistance on the Histopathologic Review of Lymph Nodes for Metastatic Breast Cancer

December 13, 2016

Development and Validation of a Deep Learning Algorithm for Detection of Diabetic Retinopathy in Retinal Fundus Photographs

Article | Published: 17 September 2018

Classification and mutation prediction from non–small cell lung cancer histopathology images using deep learning

Letter | Published: 13 August 2018

Automated deep-neural-network surveillance of cranial images for acute neurologic events

Published: 25 January 2017

Dermatologist-level classification of skin cancer with deep neural networks

Interest from health systems, government, and media

How Artificial Intelligence Could Transform Medicine

NEWS AND VIEWS · 14 MARCH 2018

Machine learning classifies cancer

NEWS · 30 NOVEMBER 2020

'It will change everything': DeepMind's AI makes gigantic leap in solving protein structures

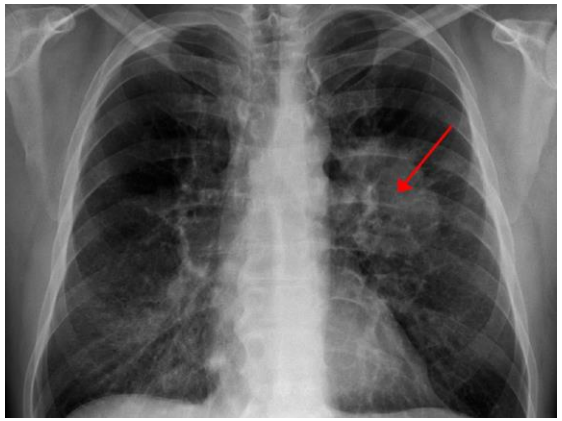
Artificial Intelligence in Healthcare: the future is amazing

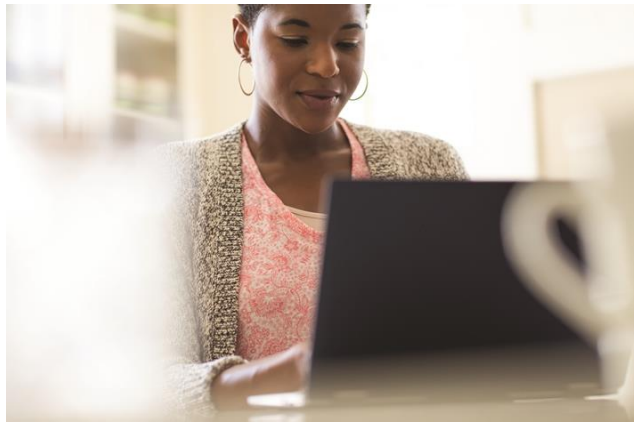
AI has yet to realize the “quadruple aim” at scale

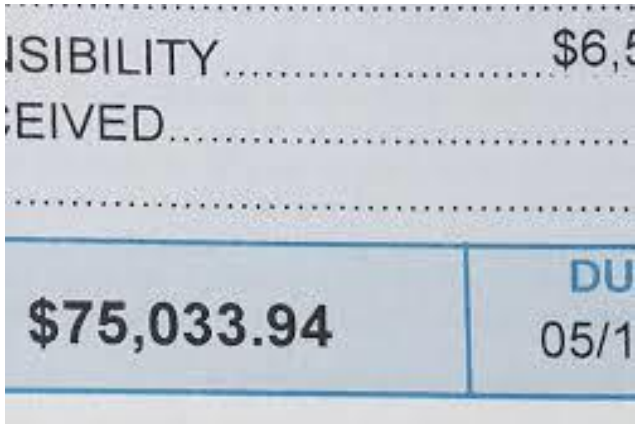
Suboptimal outcomes

Poor experiences

High costs







Delivering real-world impact with AI

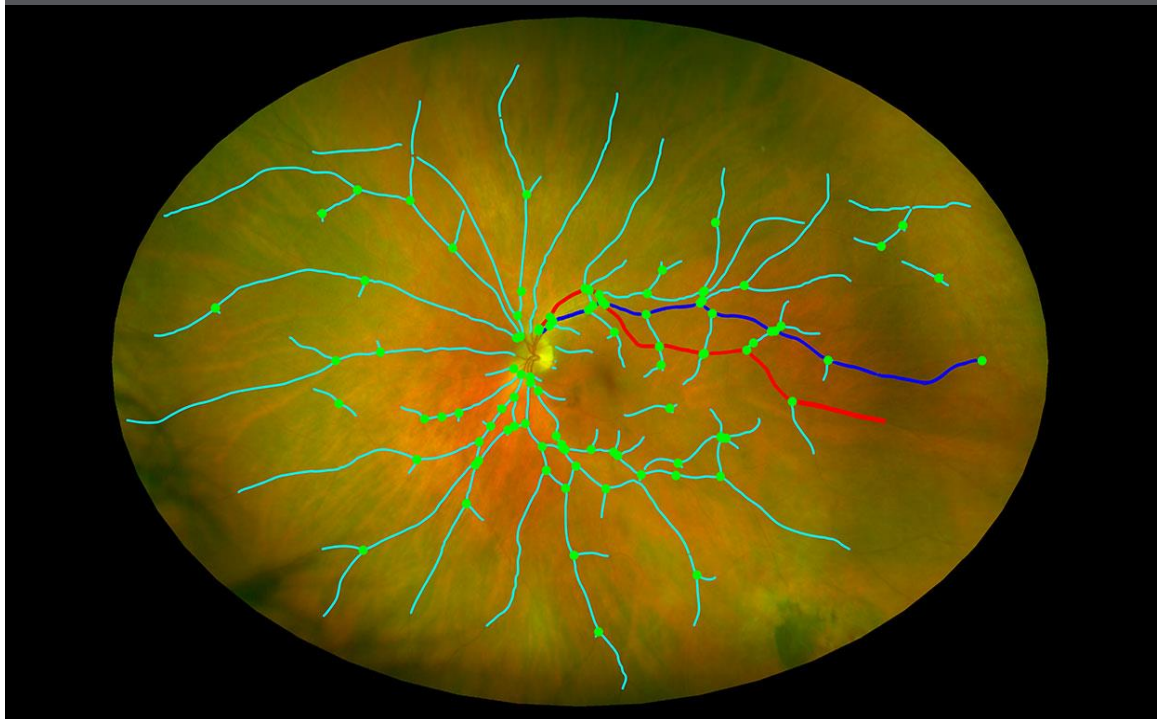
Key challenges for delivering clinical impact with artificial intelligence.

The AI Chasm

The gulf between developing a scientifically sound algorithm and its use in any meaningful real-world applications

Focus on the right problems

Scientific challenges v. real world problems



Considerations

- Prioritize meaningful business / clinical challenges that data can help drives us to – we know the pain points!
- Multidisciplinary team involved from project ideation through to deployment – engineers, research scientists, clinicians, business, compliance

Data, data, data...

AI learns from the signals we provide

Considerations

- Define a data strategy from point of collection through to delivery within products
- Train, test and validate AI systems on representative data that reflects the populations we serve
- Seek to eradicate embedded bias in data collection that can extend existing inequalities and cofounders that lead to incorrect recommendations

Delivering AI into workflows and customer journeys is complex

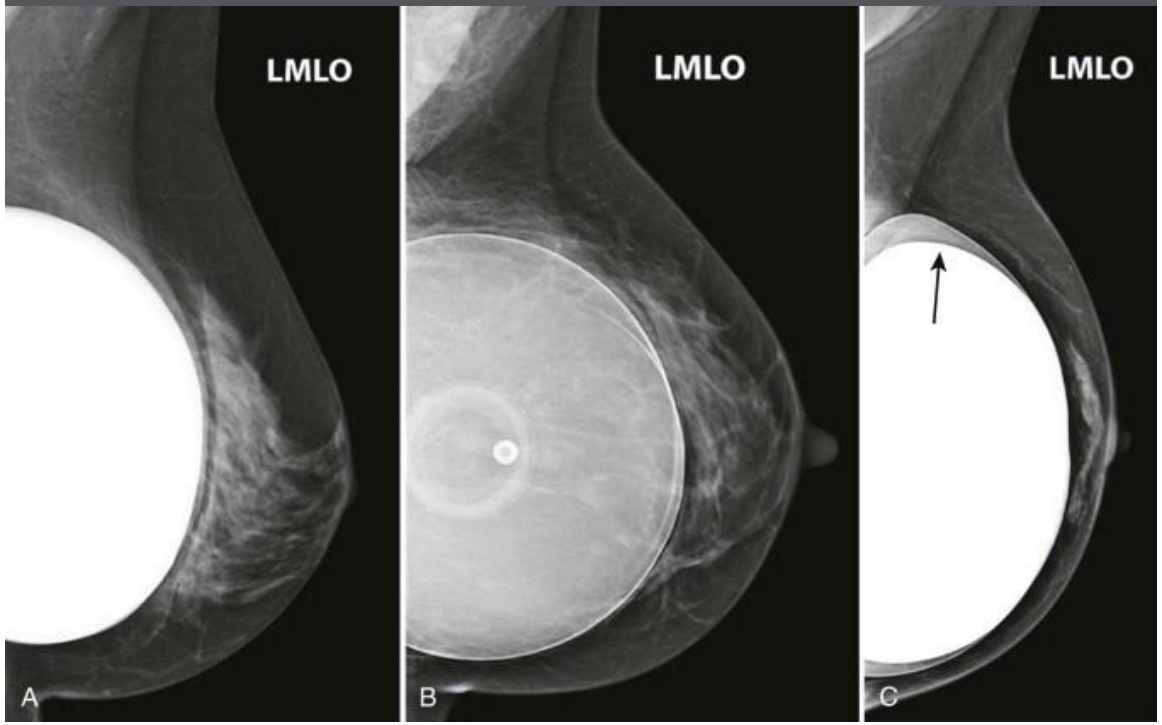
The algorithm is only a ½ of the challenge

Considerations

- Products serve as the critical engagement layer between insights and users. Where are we surfacing insights and are the products AI ready
- Be cognizant of the range of socio-technical factors that are barriers to successful technology deployments
- Think about system redesign that AI can enable

Prospective validation

Performance likely to be worse in the clinic

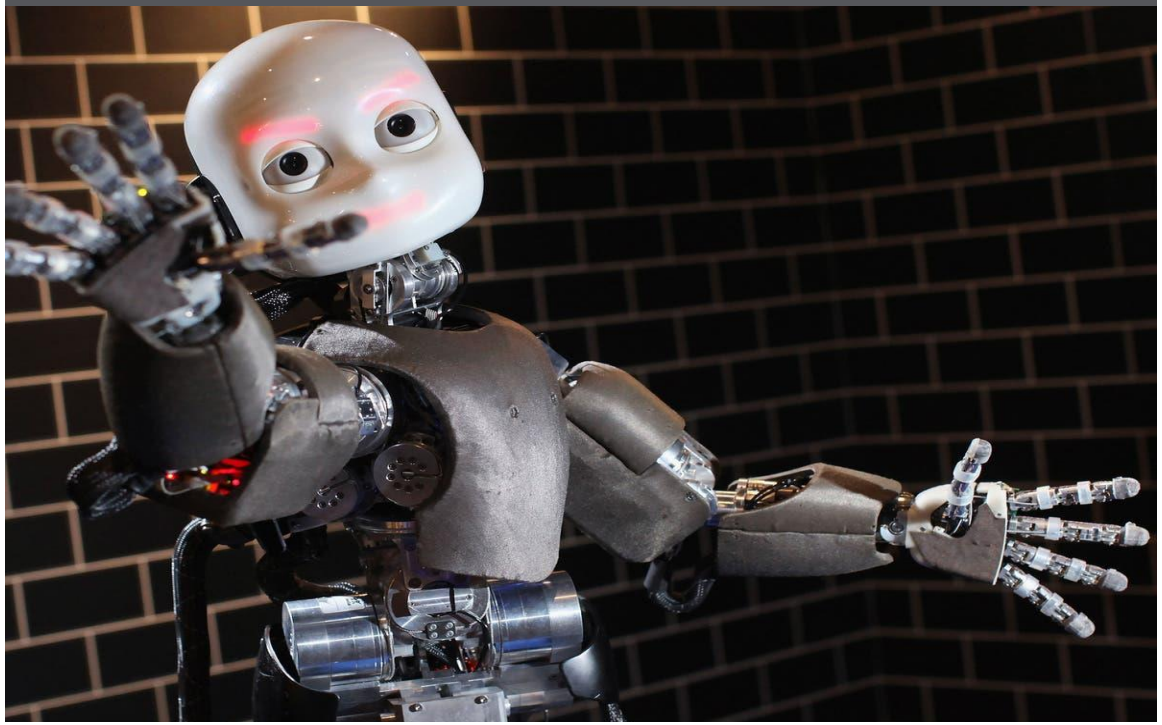


Opportunity

- Remarkedly little prospective validation of healthcare AI
- To be effective AI systems need to take account of all the challenges and edge cases seen in the clinic that may cause them to break
- Ensure prospective scrutiny once AI is ‘released into the wild’ particularly in new settings and populations

Build trust

Respond actively to concern and anxiety



Opportunity

- Assurances on privacy and security
- Transparency around data processing
- Rigorous quality control and regulatory compliance
- Engage and involve clinicians and customers involvement and engagement
- Follow new reporting guidelines for AI

Scaled impact

Mindset shift from R&D → impact

Opportunity

- We're already building a strong AI community to share best practices
- Make it easy for teams to draw on curated data, reusable tools etc.
- Get teams working as close to real data as possible and thoughtful upfront around quality and compliance considerations

Core competencies in reimagining care delivery

- Insights
- Technology
- Clinical excellence