AI IN MEDICINE

Pediatric Moonshot

We can transform children's healthcare

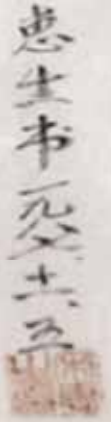
Michael R Harrison Innovation Symposium

Trailblazer Keynote

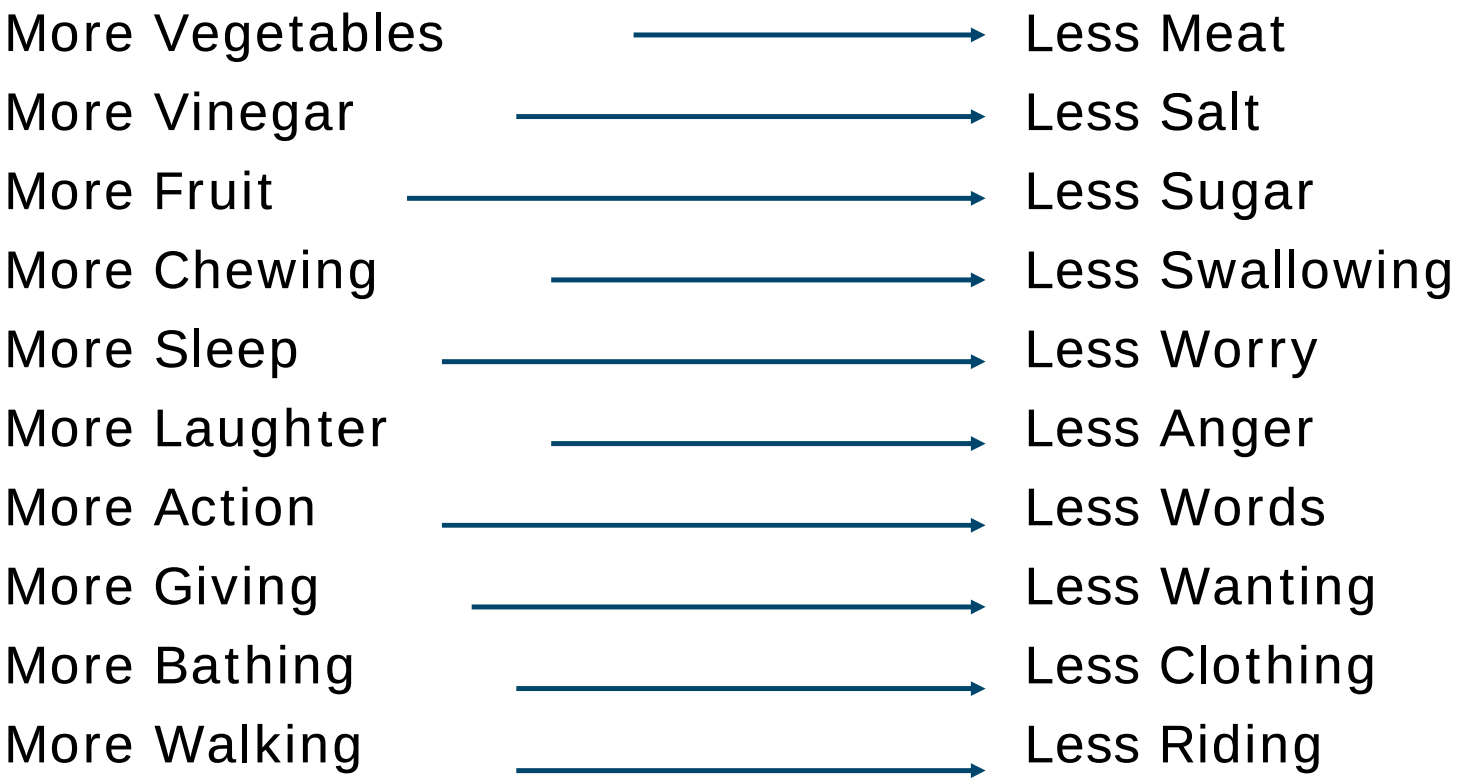
March 22, 2024

長寿十則

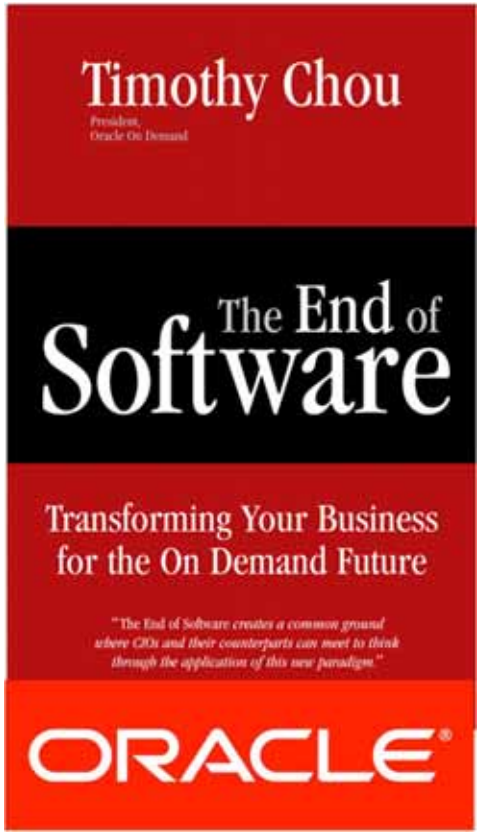
多菜少肉　多酢少塩
多果少糖　多咀少食
多眠少怏　多笑少怒
多行少言　多施少欲
多浴少衣　多歩少車



Ten Lessons for Long Life



Introduction



Stanford

Home » Courses » Cloud Computing

Cloud Computing

CS309A

STANFORD SCHOOL OF ENGINEERING

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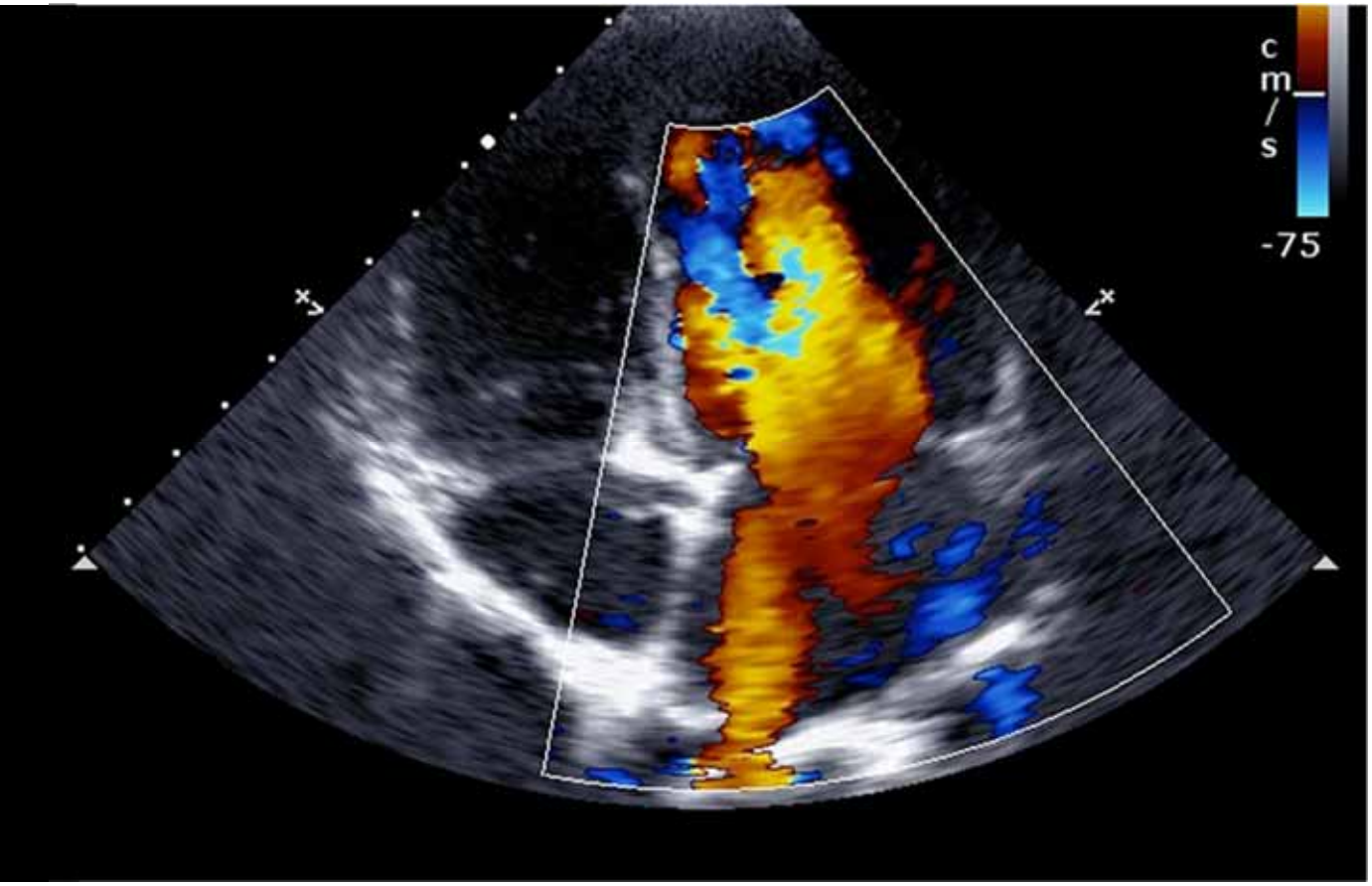
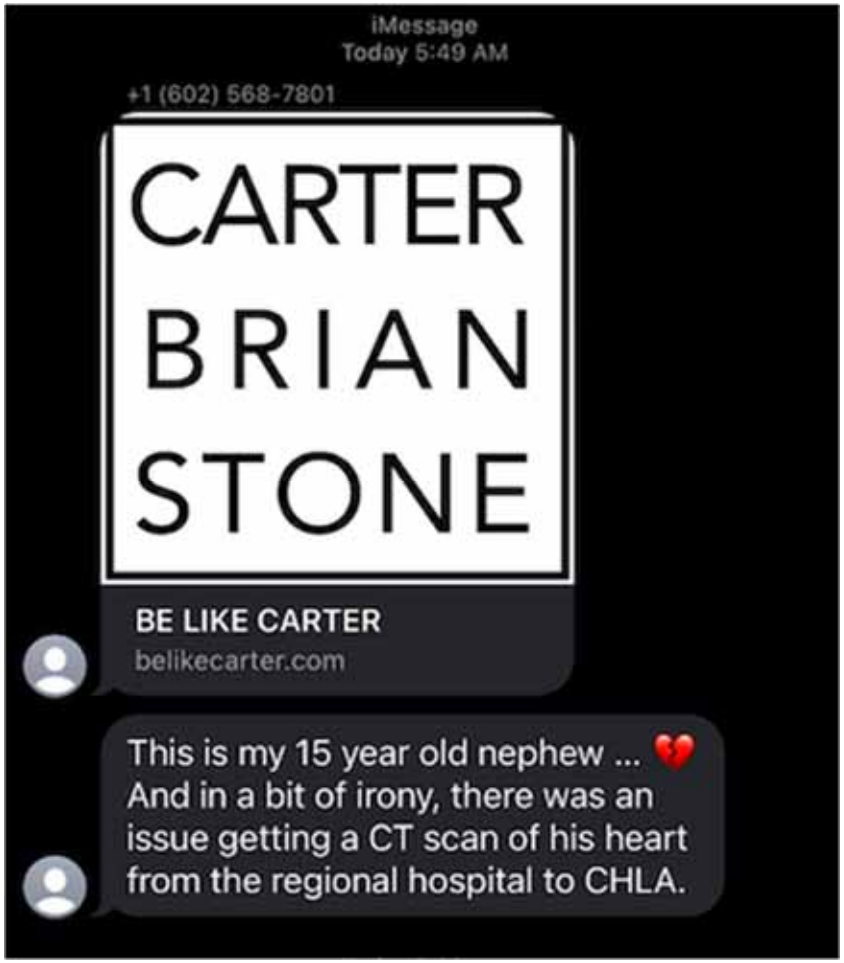


A girl dies in Myanmar because an expert pediatric cardiologist in the US can’t see her echo.

BevelCloud



"there was an issue getting a CT scan of his heart from the regional hospital to CHLA"

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“Today’s solutions are not simple or automatic”

Dr. Chris Newton

Medical director, Trauma and surgery services, UCSF

Today: rural hospital in Willits, CA sends CD-ROMs in an emergency

Willits, CA population: 4,969

"Training every single ER Tech that rolls through how to use the current solutions is way too convoluted …"

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Pediatric clinical expertise is increasingly geographically concentrated in the 500 children’s hospitals

The New York Times

Account

As Hospitals Close Children’s Units, Where Does That Leave Lachlan?

Adult beds are more lucrative than children's beds. So as institutions look to boost profit margins, pediatrics is often among the first services to be cut.

State

Montana

South Dakota

Wyoming

have **no** pediatric emergency physicians

State

Alaska

North Dakota

New Mexico

have pediatric emergency physicians in only **1** county

USA

60%

of rural hospitals have no pediatric expertise

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Mexico

Congenital Heart Disease is the

#2

cause of death in Mexico

India

300

pediatric cardiologists in India

Africa

1 children's hospital

in all of east Africa

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Why do we care?

Long Tail

FCD a brain lesion appears only **25K** times/year

no one pediatric neuro-radiologist sees enough cases

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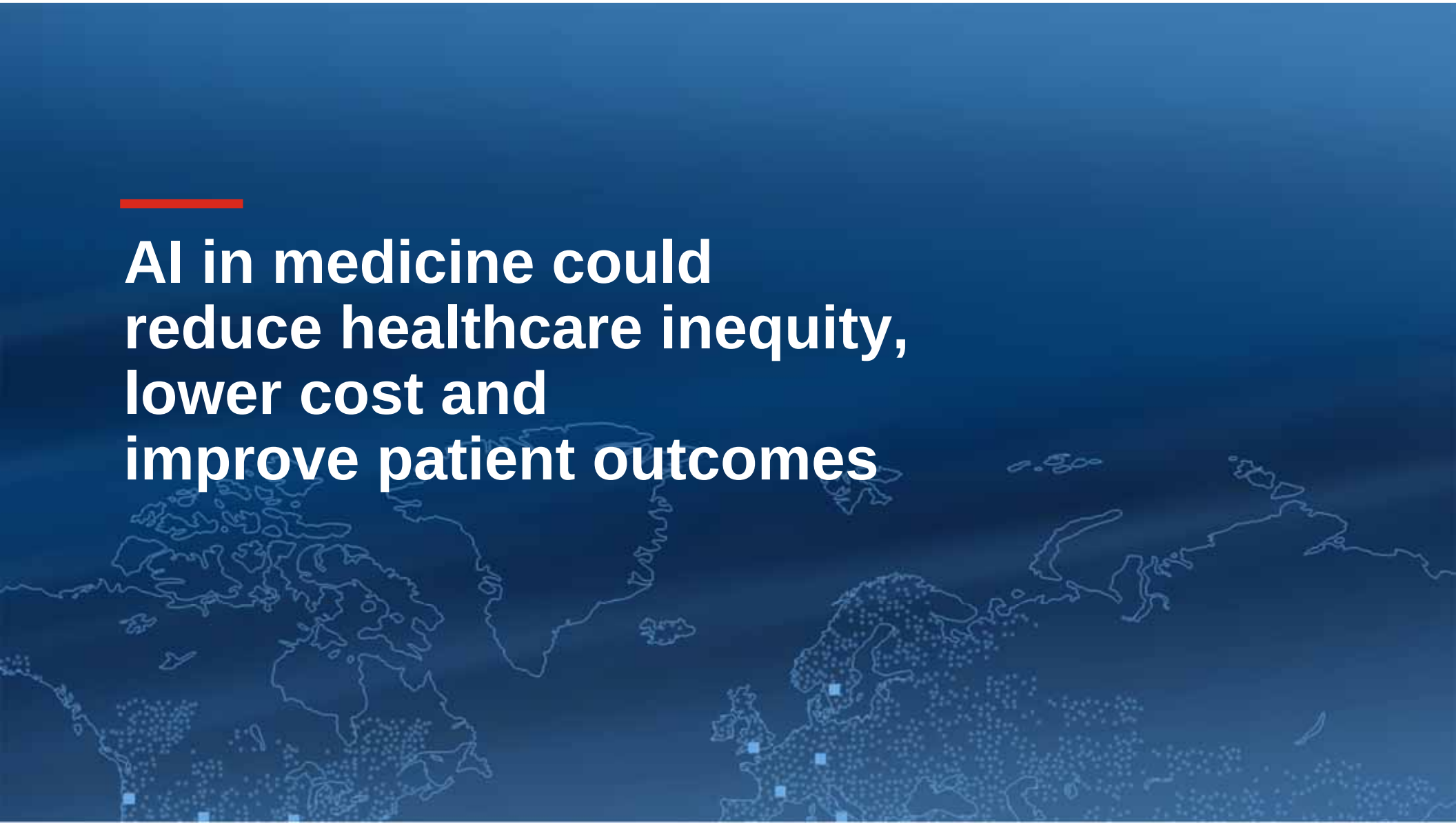
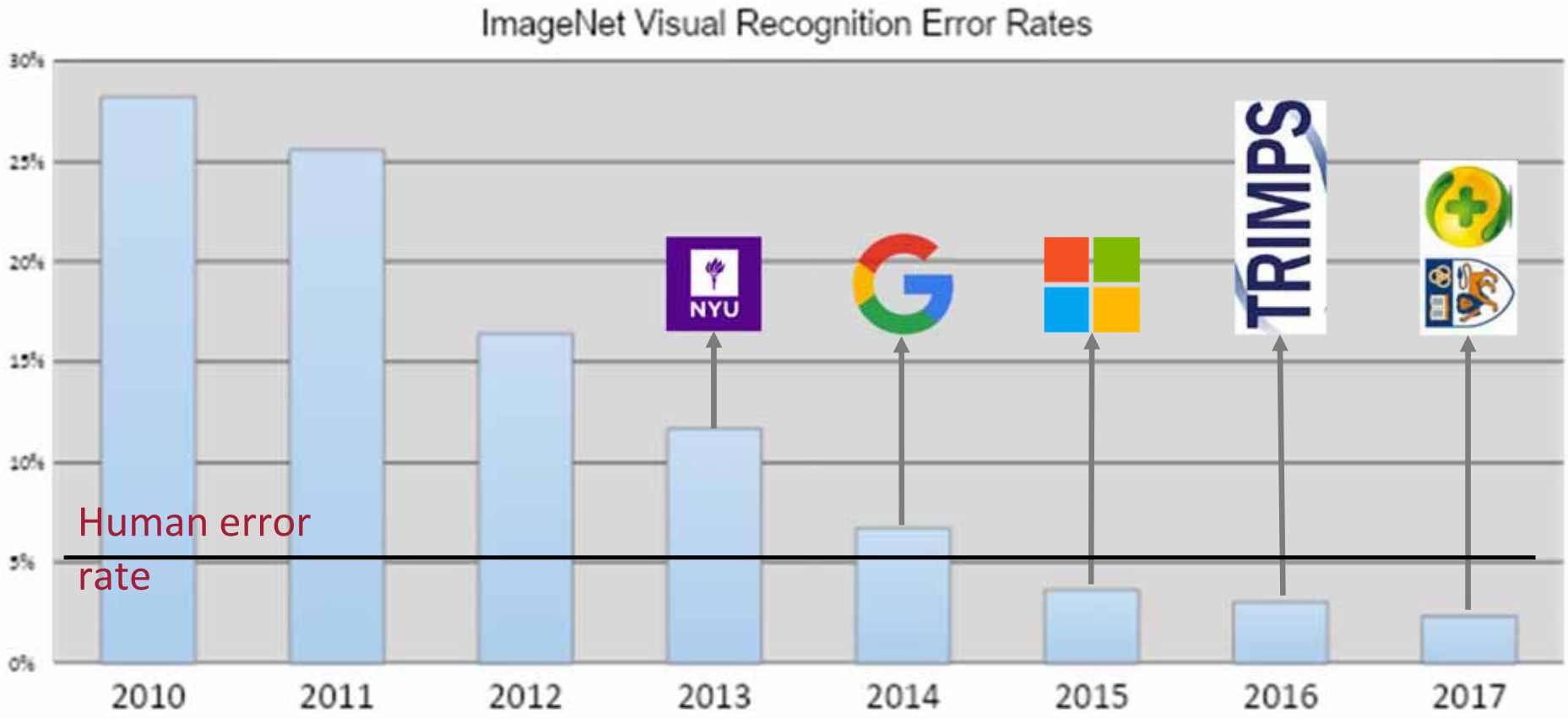

AI in medicine could
reduce healthcare inequity,
lower cost and
improve patient outcomes

Dramatic Advances in Accuracy of Deep Learning



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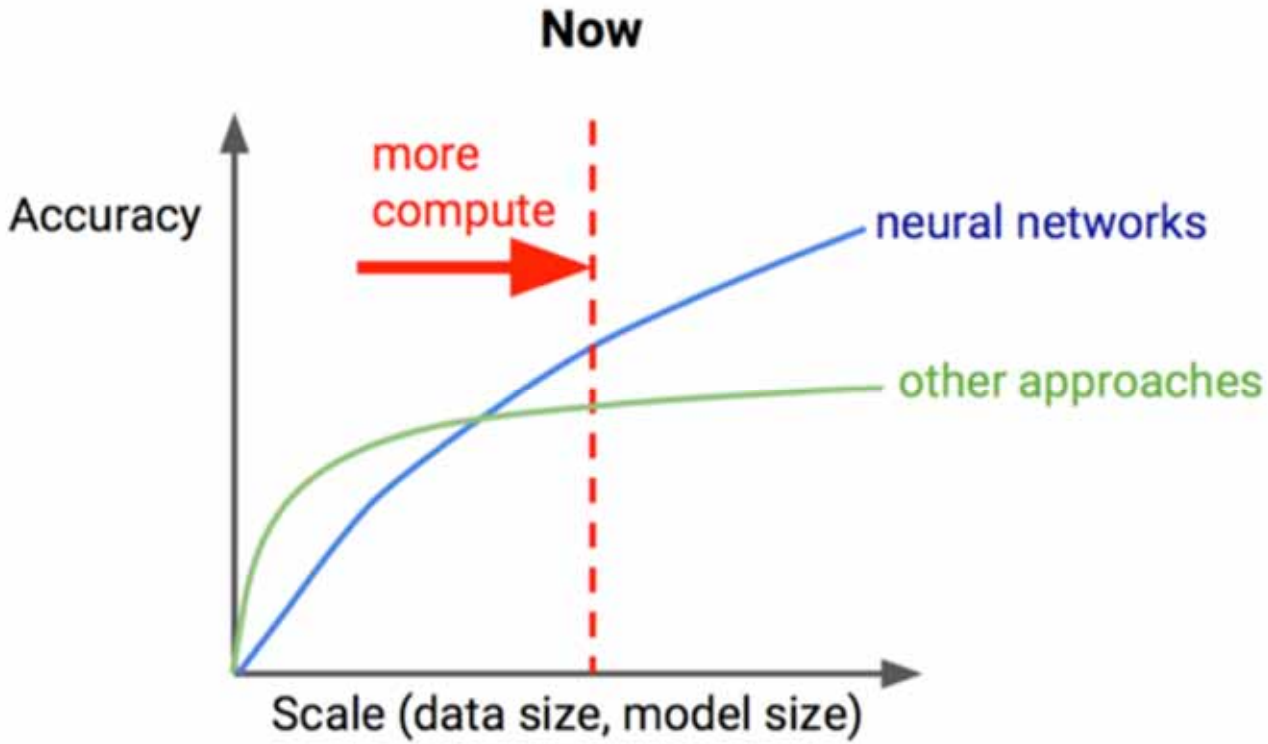
Courtesy of Curt Langlotz

How? Neural Networks



Courtesy, Jeff Dean, Google

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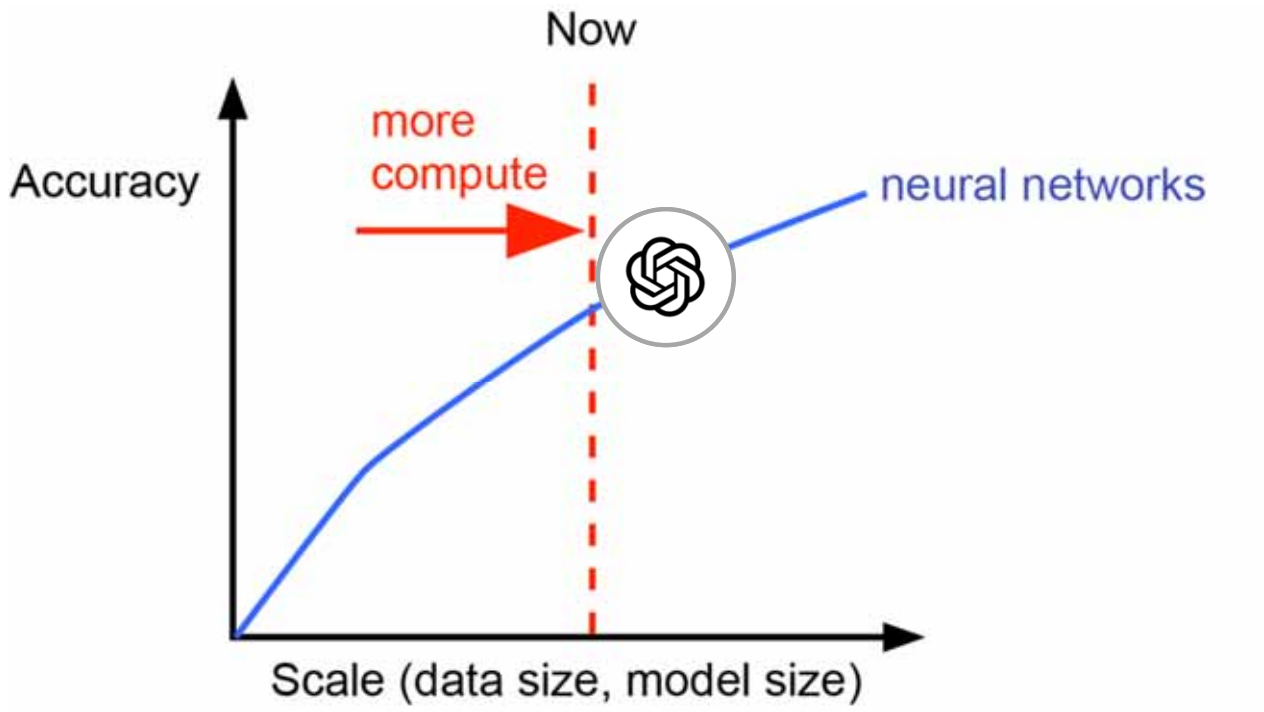
ChatGPT has achieved accuracy with large amounts of language data



Courtesy, Jeff Dean, Google

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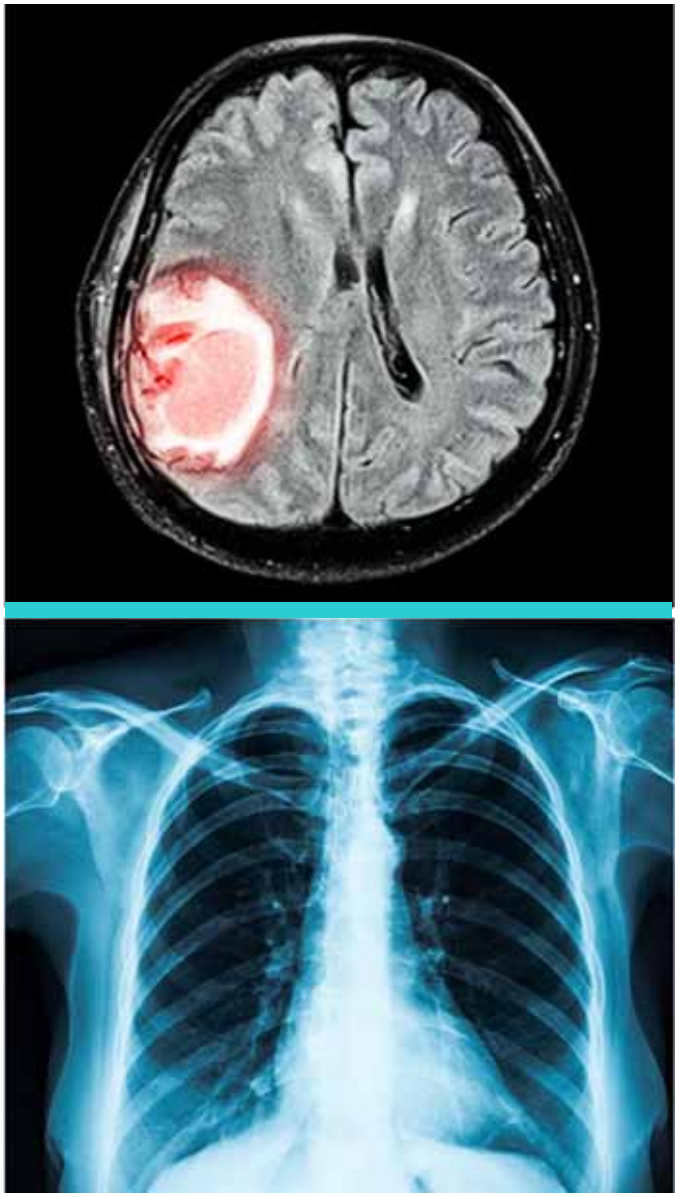
But AI for medical imaging is not performing

..studies have shown that the performance of many radiologic AI models ***worsens when they are applied to patients who differ from those used for model development****…*

The Current and Future State of AI Interpretation of Medical Images
Pranav Rajpurkar, Ph.D., and Matthew P. Lungren, M.D., M.P.
June 2023

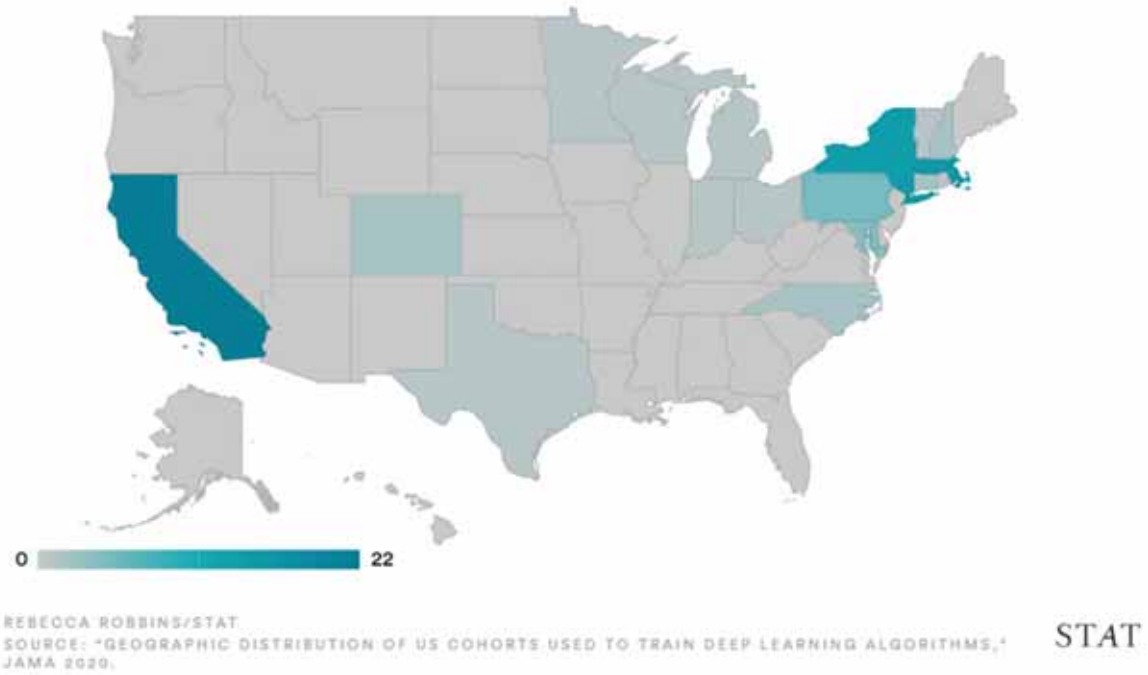
The NEW ENGLAND JOURNAL of MEDICINE



Why? Data for AI training is NOT diverse nationally

Three states provide almost 70% of the data in adult medicine

Only 13 of the remaining 47 provide any data



Kaushal A, Altman R, Langlotz C. JAMA. 2020;324: 1212–1213.

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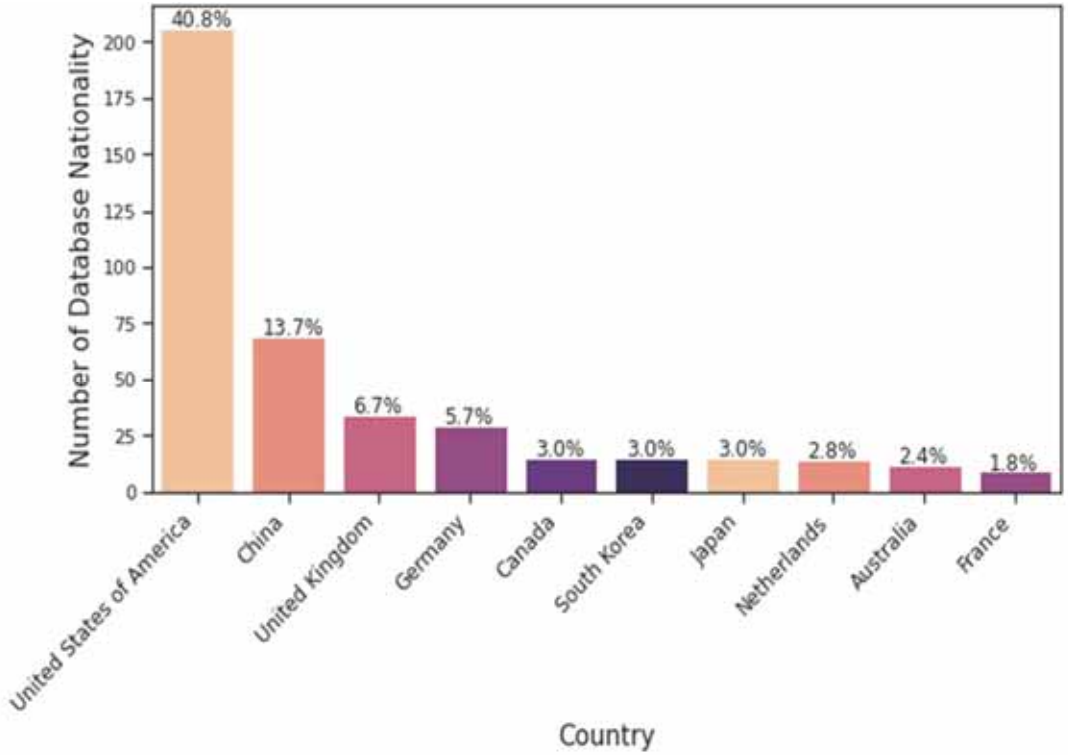
Courtesy of Curt Langlotz

Data for AI training is NOT diverse globally
2 countries provide 50+% of the data used to train AI applications,
8 countries of the 193 remaining countries supply the rest.



Celi LA, Cellini J, Charpignon M-L, Dee EC, Dernoncourt F, Eber R, et al. Sources of bias in artificial intelligence that perpetuate healthcare disparities—A global review. PLOS Digital Health. 2022. https://doi.org/10.1371/journal.pdig.0000022

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Courtesy of Curt Langlotz


PEDIATRIC MOONSHOT
Reduce healthcare inequity, lower cost and improve outcomes
for children rurally, nationally and globally
by creating privacy-preserving, real-time AI applications
based on access to data from 1,000,000 healthcare machines
in all 500 children's hospitals in the world

Like the original moon shot we need to build a new rocket

Global, highly decentralized, in-the-building cloud service

- Edge Networking Service
- Pediatric Applications
- Edge Data Services
- Digital Twin Applications
- Edge Compute & Storage

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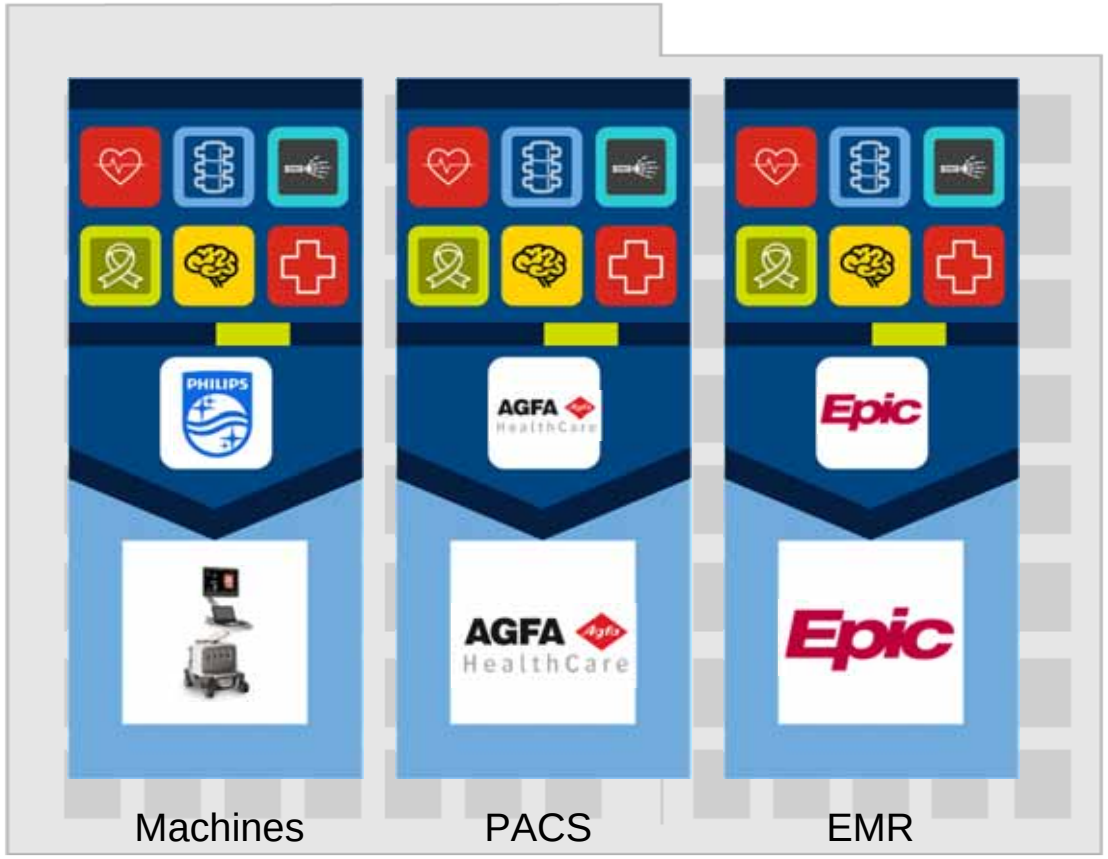
Enable authorized applications
Access to data in real-time machines, offline PACS & EMRs



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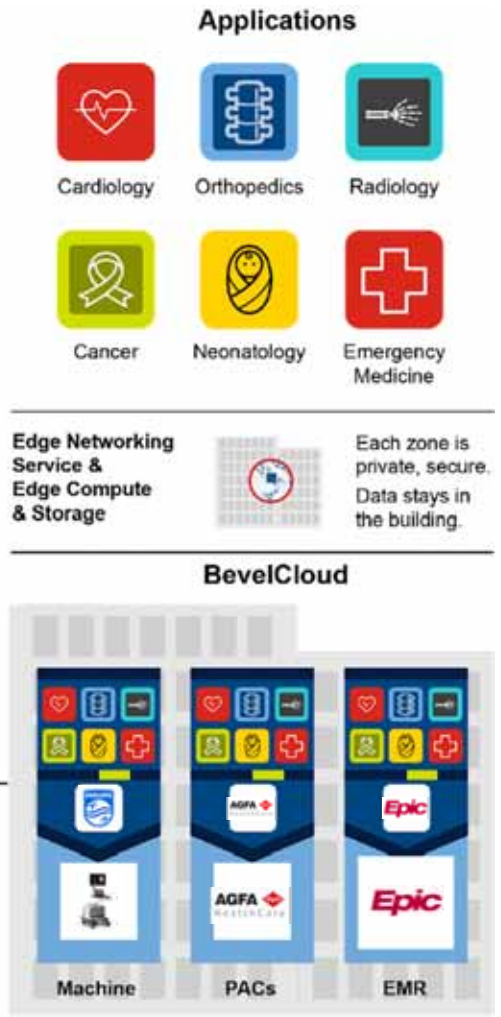
Deployed globally in-the-building



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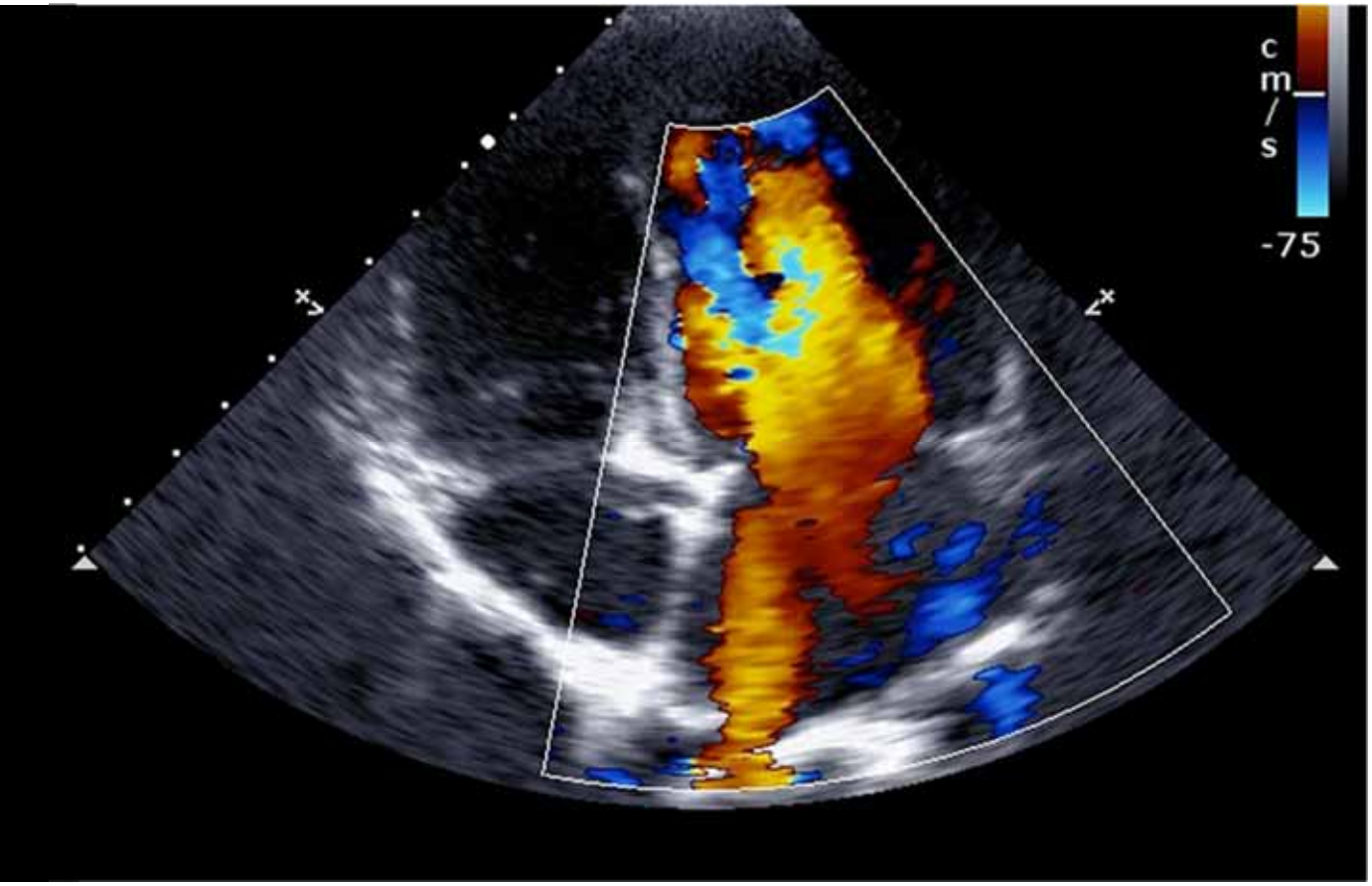
Bevelcloud enables
building and deploying pediatric applications
like Apple enables
building and deploying consumer applications

Real-time image sharing application across 6,000 miles
https://youtu.be/844RjN-3pPM

CLINICAL APPLICATION

Mercury

A Worldwide Image Sharing Network
Share with Pediatric Clinical Experts



A girl dies in Myanmar because an expert pediatric cardiologist in the US can’t see her echo.

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“Today’s solutions are not simple or automatic”

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Medical director, Trauma and surgery services, UCSF

Simple
Real-time, privacy-preserving real-time emergency image sharing

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As simple as Instagram

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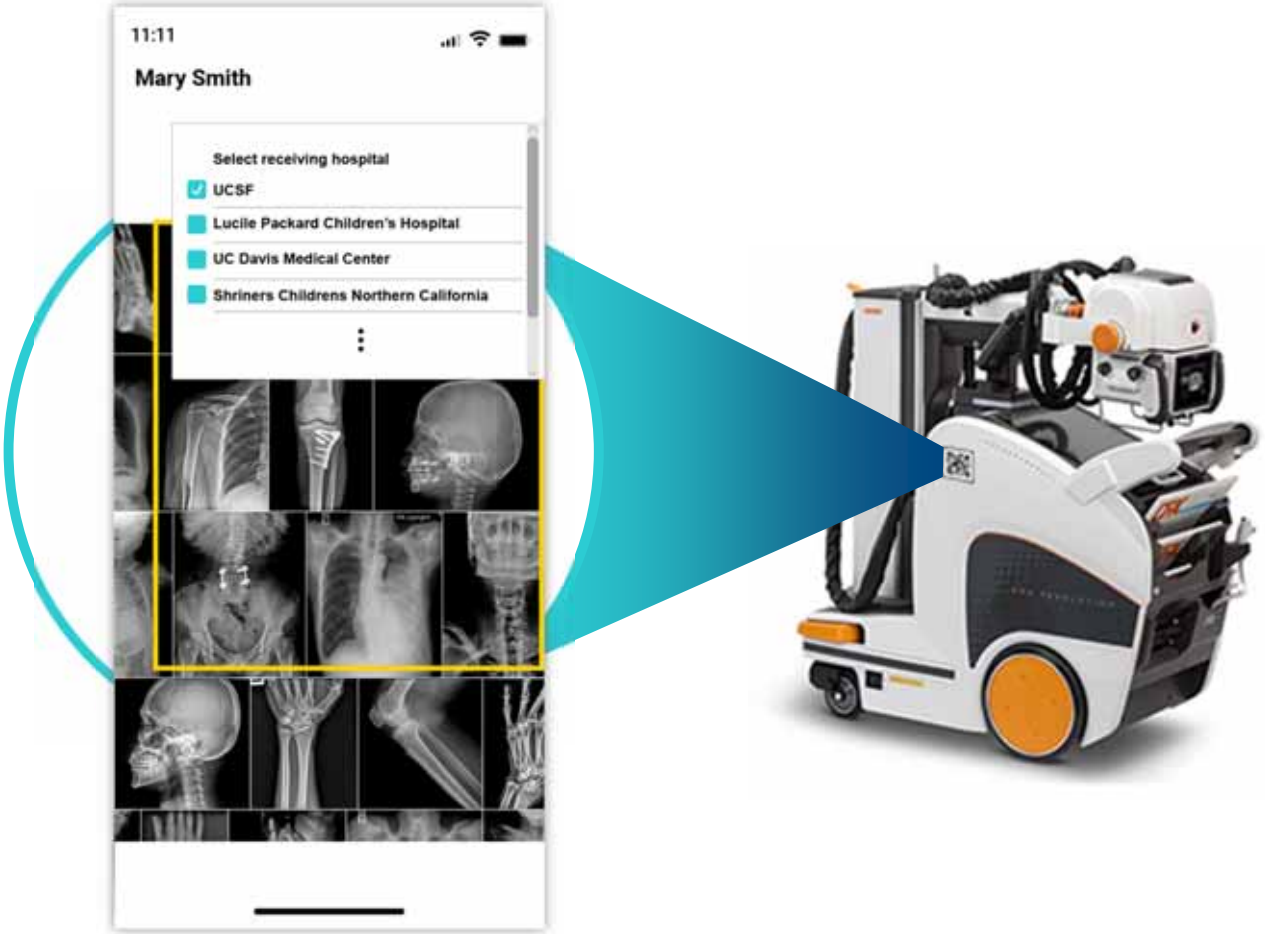
Select to share with UCSF, Stanford, Davis, Shriners



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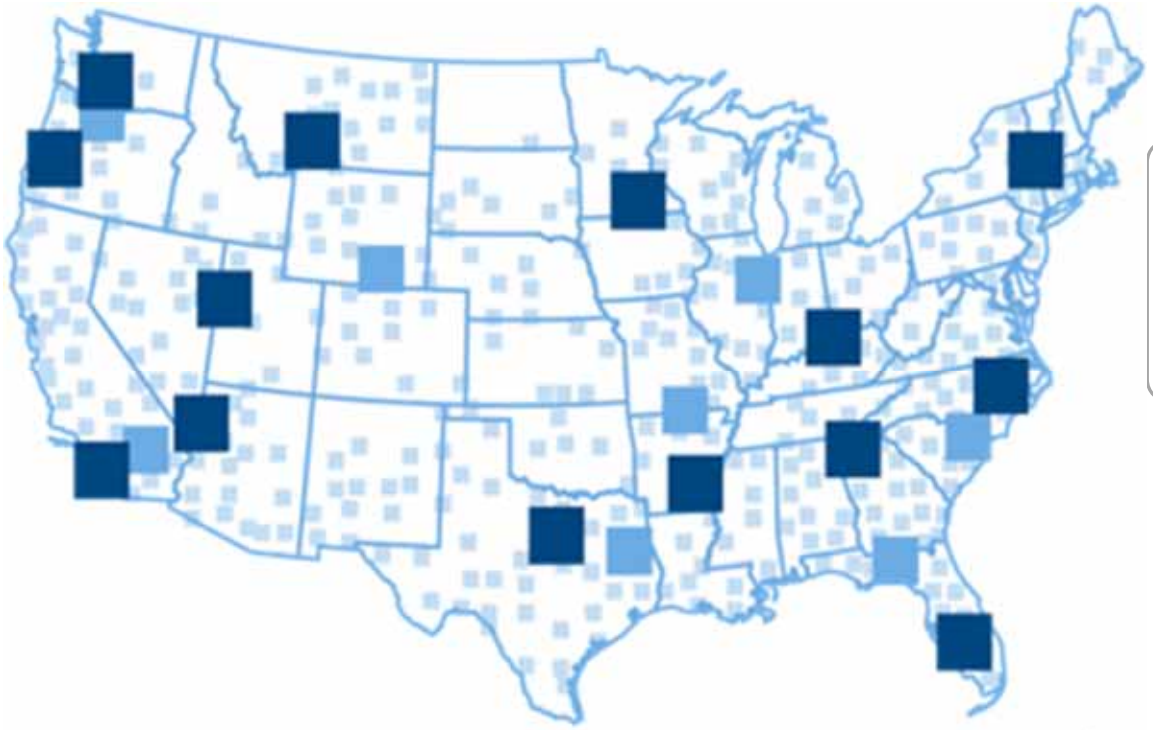
Mercury: a **simple, automatic, nationwide** image sharing network to allow non-children's hospitals or clinics to collaborate with experts at the children's hospitals in all 50 states



PHASE 1

500 Rural Hospitals or Clinics

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Worldwide Network for 2nd opinions

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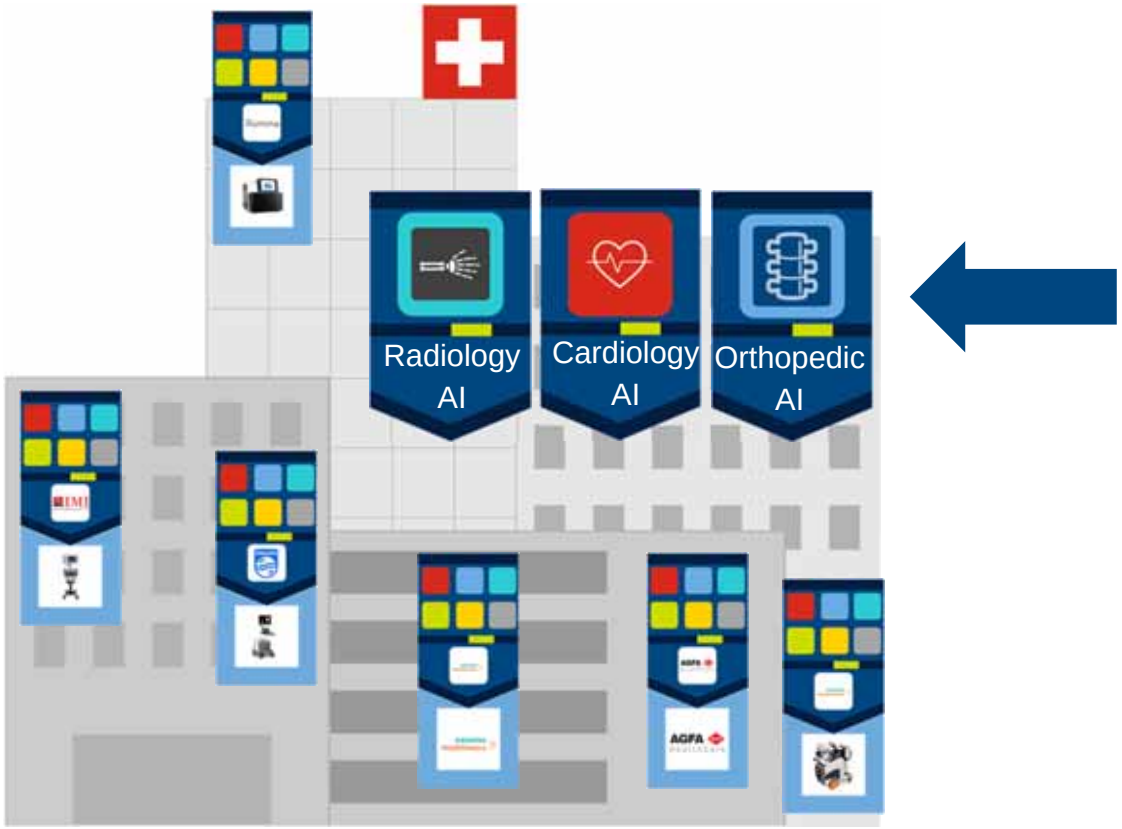
If you can share with a clinical expert
you could also share with an AI expert in the building



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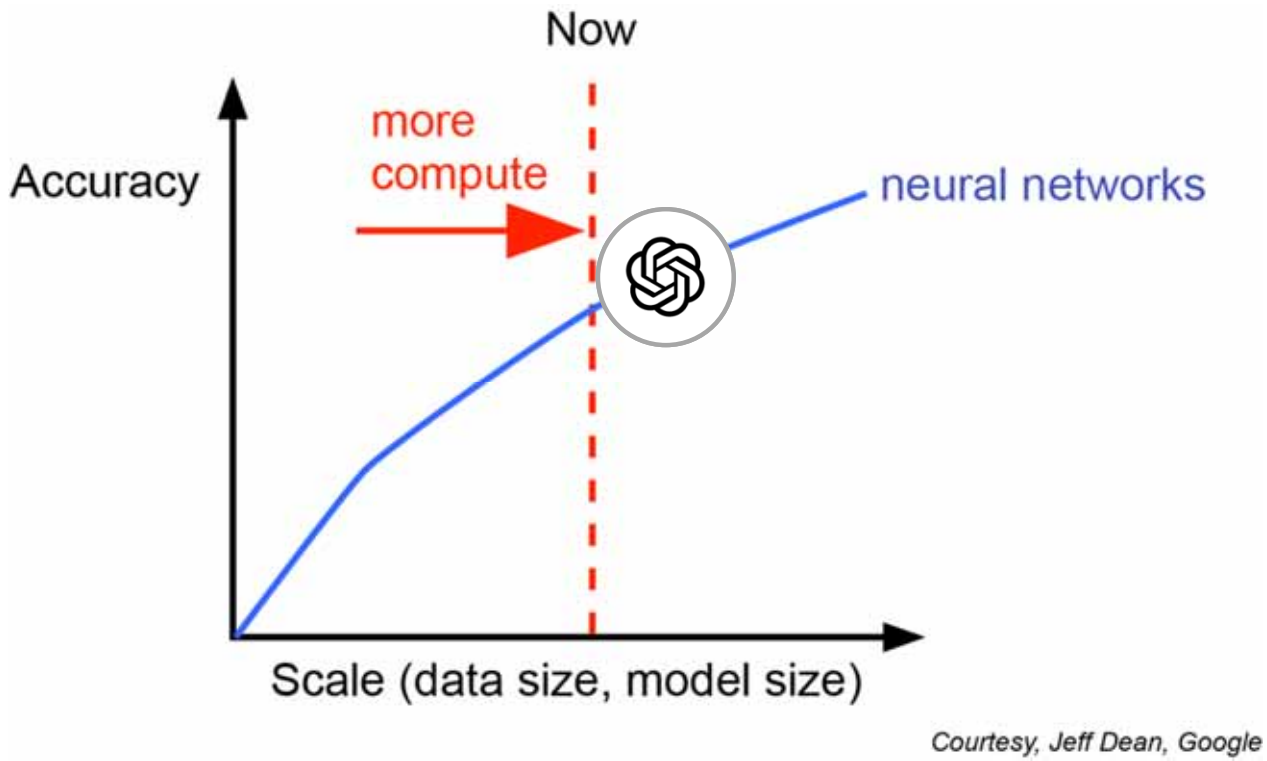
RESEARCH APPLICATION

Gemini

AI Research Lab for children’s medicine

ChatGPT has achieved accuracy with large amounts of language data



Courtesy, Jeff Dean, Google

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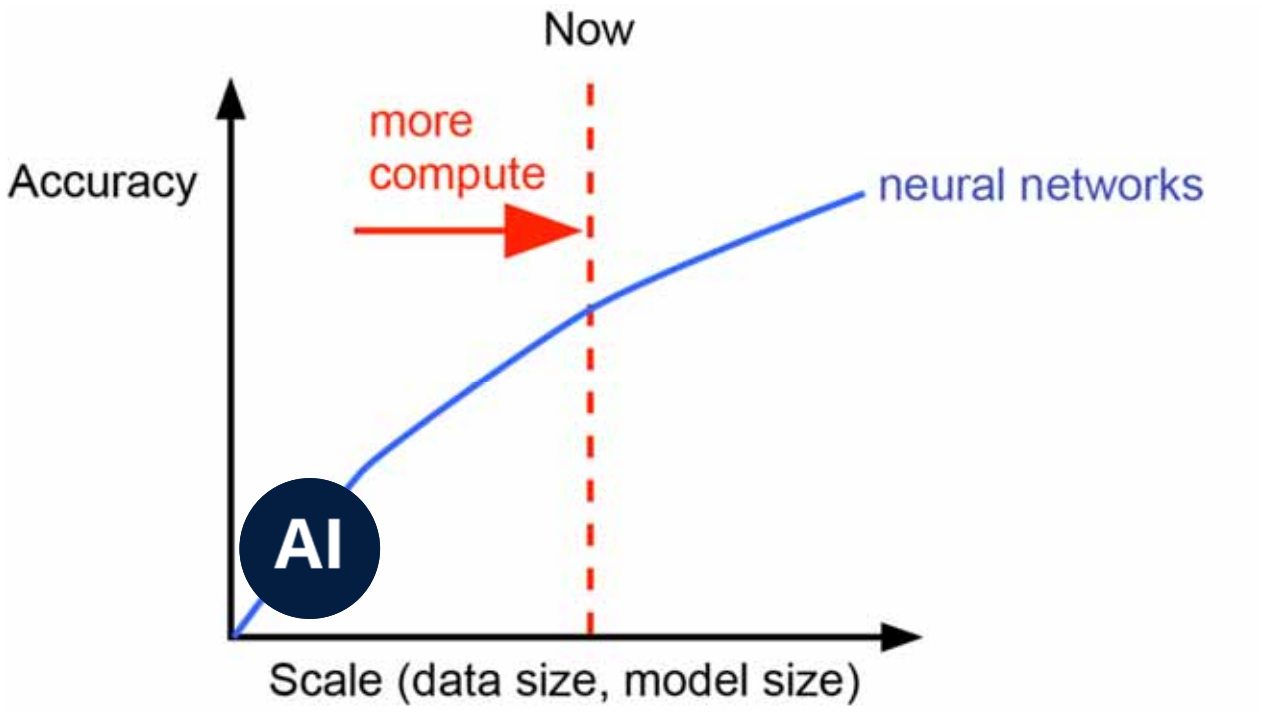
However, AI in medicine applications are trained on small amounts of image data



Courtesy, Jeff Dean, Google

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But there is plenty of data – BIG data

- The 500 children's hospitals echo labs generate ~6,000,000 TB of *labeled* image data per year
- *NIH IDC is 40TB*

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However centralized architecture will NOT work for AI in medicine

- Not network preserving
- Not real time
- Not privacy preserving

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Consumer world has designed a way to learn while preserving privacy using federated learning

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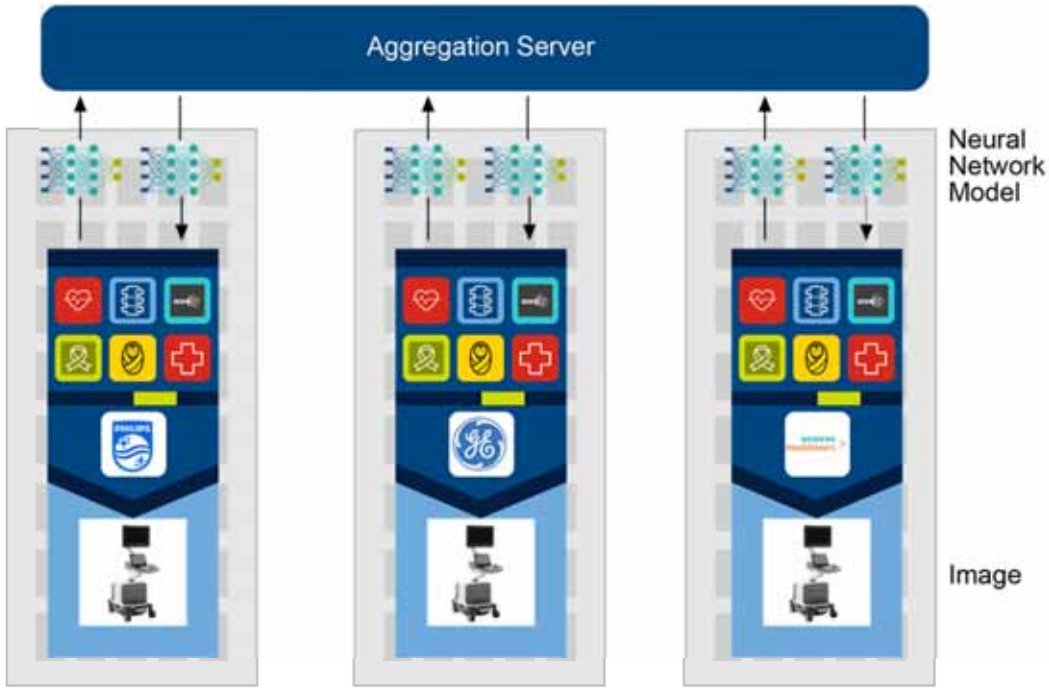
We can apply Federated Learning for AI in medicine

Privacy and network preserving



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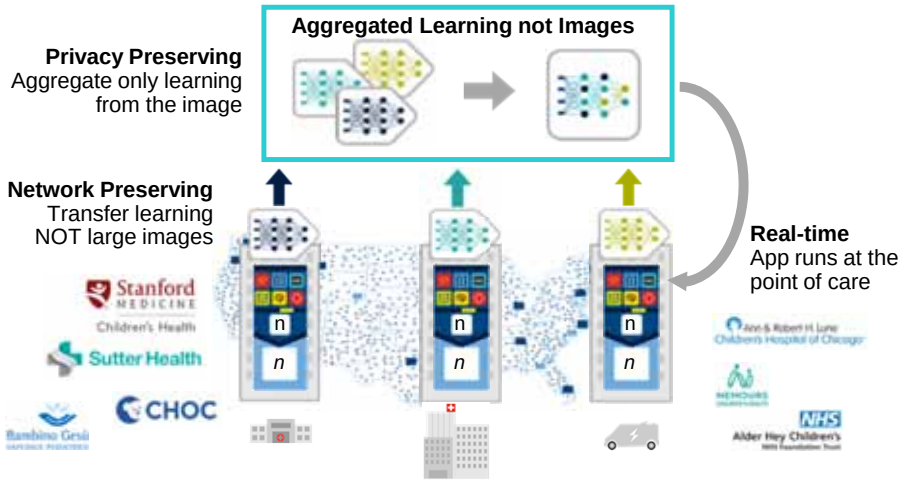
Gemini: AI Research Lab infrastructure for children's medicine



n, *or n* = any ultrasound, PACS, EMR

- **Edge network services** are designed for 5G as well as satellite communications.
- **Applications:** Cardiology, Orthopedics, Radiology, Oncology, Neurology, ER
- **Edge Data Services** provides common data standards to real-time data from static (serial number, OEM), environmental (location, temperature), dynamic (error codes; log files), nomic (Echo, MRI, Blood Analysis, Genome) data from the machines and the EV.
- **Digital Twin Applications e**nables access to online data from any ultrasound and offline data from applications
- **Edge compute, storage** are designed with over 30 security and privacy features.

32
Children's Hospitals

ALL
imaging

1600
Edge cloud servers

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Completing the Mission will change the future for children locally, rurally and globally

Emergency Medicine AI Application

Neurology Applications

Oncology AI Applications

.

Orthopedic AI Applications

Cardiology AI Applications

Neonatology AI Applications

Radiology AI Application

Rare Disease AI Applications

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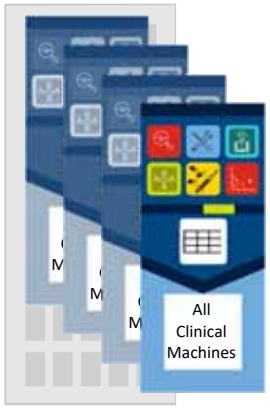
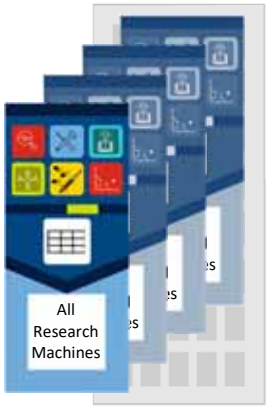
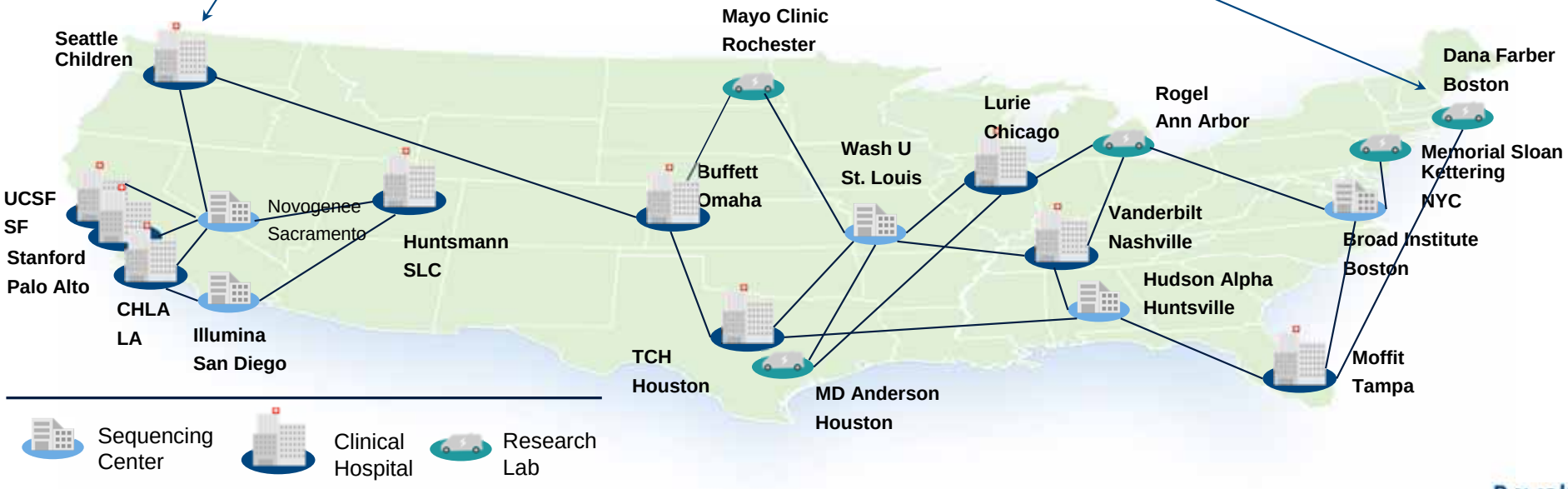
Nationwide cancer treatment and analysis platform

Clinical Data
Ultrasound
CT
MRI
Xray
Microscope
Blood Analyzer
ECG/EKG
Bedside Monitor





Research Data
Next-generation sequencers (NGS)
RNA sequencers
Sanger sequencers
Single-molecule sequencers microarrays
Nuclear magnetic resonance (NMR) spectrometers
Mass spectrometers
Multiplex immunofluorescence imaging systems
Spatial transcriptomic equipment
Multiplexed ion beam imaging (MIBI) machines
Spatial proteomics imaging systems
Spatial genomic machines



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Research Machines

- Next-generation sequencers (NGS)
- RNA sequencers
- Sanger sequencers
- Single-molecule sequencers microarrays
- Nuclear magnetic resonance (NMR) spectrometers
- Mass spectrometers
- Multiplex immunofluorescence imaging systems
- Spatial transcriptomic equipment
- Multiplexed ion beam imaging (MIBI) machines
- Spatial proteomics imaging systems
- Spatial genomic machines

Clinical Machines

- Ultrasound
- CT
- MRI
- Xray
- Microscope
- Blood Analyzer
- ECG/EKG
- Bedside Monitor

Edge Compute & Storage

Thirty security and privacy features

Digital Twin application

Improve the volume of cancer data by twinning to research and clinical data at the source. The architecture is scalable to any new machines

Edge data services

Edge data services annotates, standardizes and harmonizes data at the source ensuring compatibility and consistency across data types and structures

Standard persistent metadata (e.g., decentralized ID)

De-identified optionally

Fine grain privacy-preserving data sharing

Applications

Collaborate
Model
Analyze
Learn
Biomarker
Drug Therapy

Edge networking services

Enable secure networking inside the zone and outside

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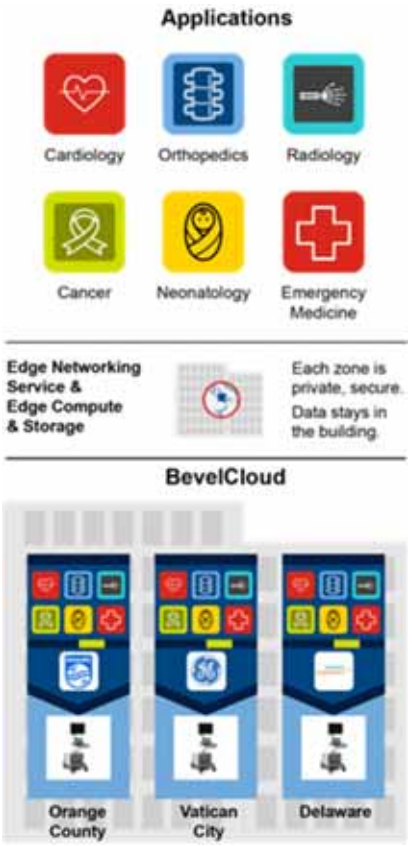
Economics

The Funding Challenge

Funding challenge



We have the Technology

We have Children's Hospitals' Support

PHASE 1

Mercury & Gemini

$112M

We Need Funding

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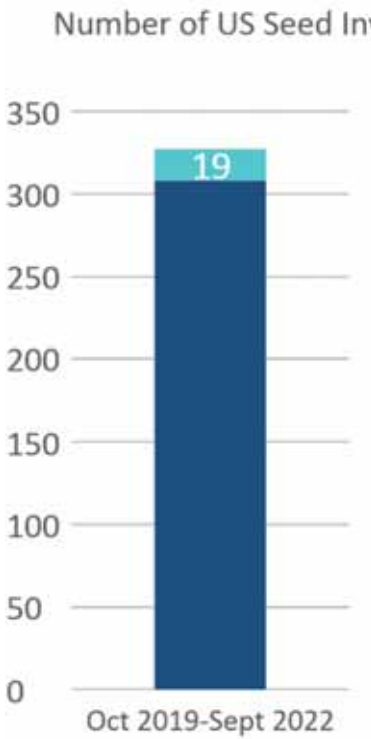
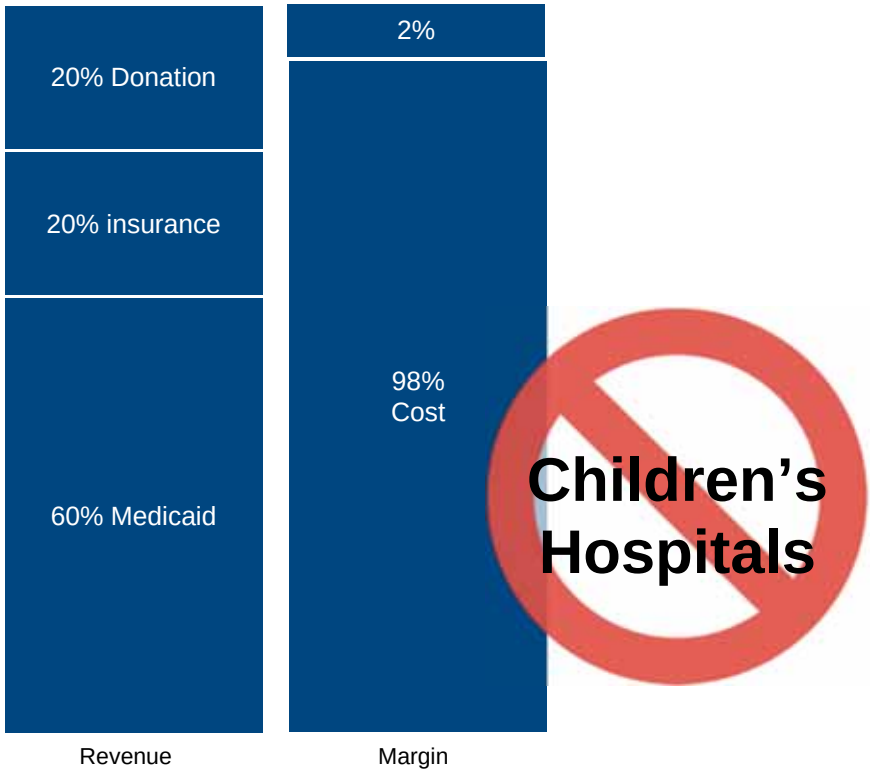
Where funding is NOT viable



Product Market	#	Funding ($M)	% of Funding
Peds & adults	[illegible]	[illegible]	[illegible]2.8%
Only peds	5	$5.7	7.2%
Total	19	$78.5	100%

VC

Over 3 years (2019-2022): $5.7M of seed funding for pediatric innovation



NOT funded by the hospitals due to the Children's Hospital Economics model

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Government sponsorship of the Pediatric Moonshot

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Corporate Sponsorship

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Example of co-branding

Children are 25% of the world’s population but 100% of our future.

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Join the Pediatric Moonshot Crew

- Register for the newsletter www.pediatricmoonshot.com
- Subscribe to the YouTube channel https://www.youtube.com/@PediatricMoonshot/featured
- Subscribe to the podcast https://pediatricmoonshot.buzzsprout.com

Podcast guests:
Dr. Anthony Chang, who inspired the mission and is Chief Innovation Officer at CHOC
Dr. Marc LaLande, VP of Research at Shriners.
Dr. Laura Jana, who with her books and TED talks advocates for children's healthcare worldwide.
Dr. Diana Ferro, who has returned to Italy to be a leading Research & Data Scientist @OPBG
Dr. Charitha Reddy, Clinical Assistant Professor, Pediatrics - Cardiology at Stanford Children’s
Dr. Rubin Pillay, Professor of Medicine and Assistant Dean, School of Medicine University of Alabama
Dr. Hanmin Lee, Chief, Division of Pediatric Surgery, UCSF
Dr. Wyman Lai, Co-Medical Director, CHOC Heart Institute at CHOC Children's, author of the seminal text on echocardiography

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Reduce healthcare inequity, lower cost and improve outcomes
for children rurally, nationally and globally
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based on access to data from 1,000,000 healthcare machines
in all 500 children's hospitals in the world

長寿十則

多菜少肉　多酢少塩
多果少糖　多咀少食
多眠少怏　多笑少怒
多行少言　多施少欲
多浴少衣　多歩少車