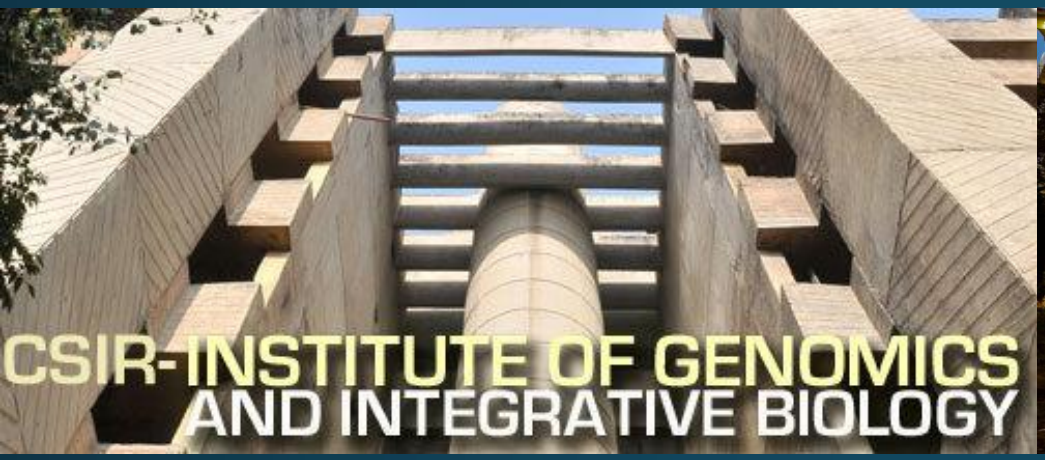
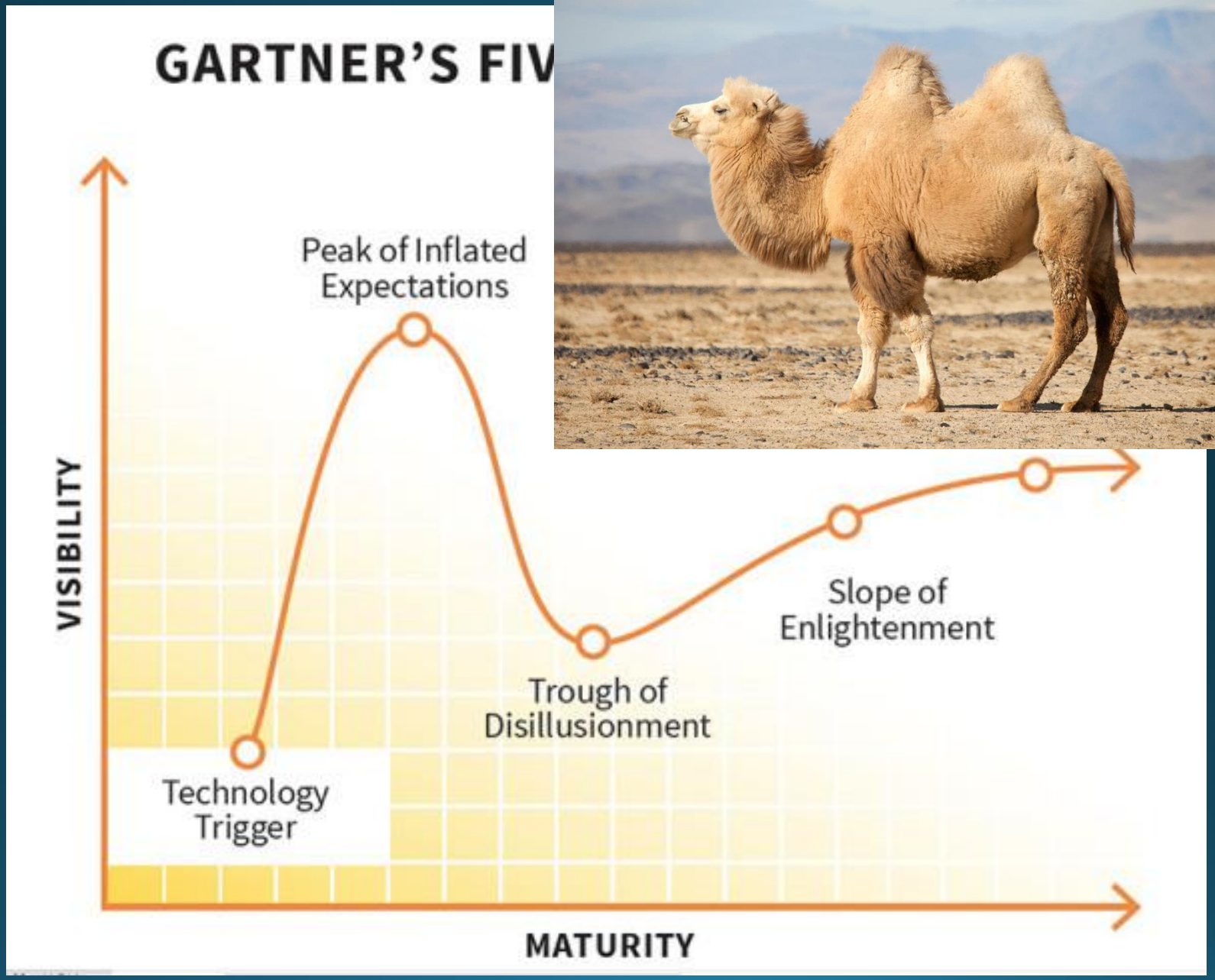


Fundamentals of AI for Health

Anurag Agrawal

IGIB
INSTITUTE OF GENOMICS & INTEGRATIVE BIOLOGY

wellcome trust DBT
INDIA ALLIANCE


GARTNER'S FIV
Peak of Inflated Expectations
Slope of Enlightenment
Trough of Disillusionment
Technology Trigger
VISIBILITY
MATURITY

Fundamentals of AI-Health 1:
Health is the better half of AI-health

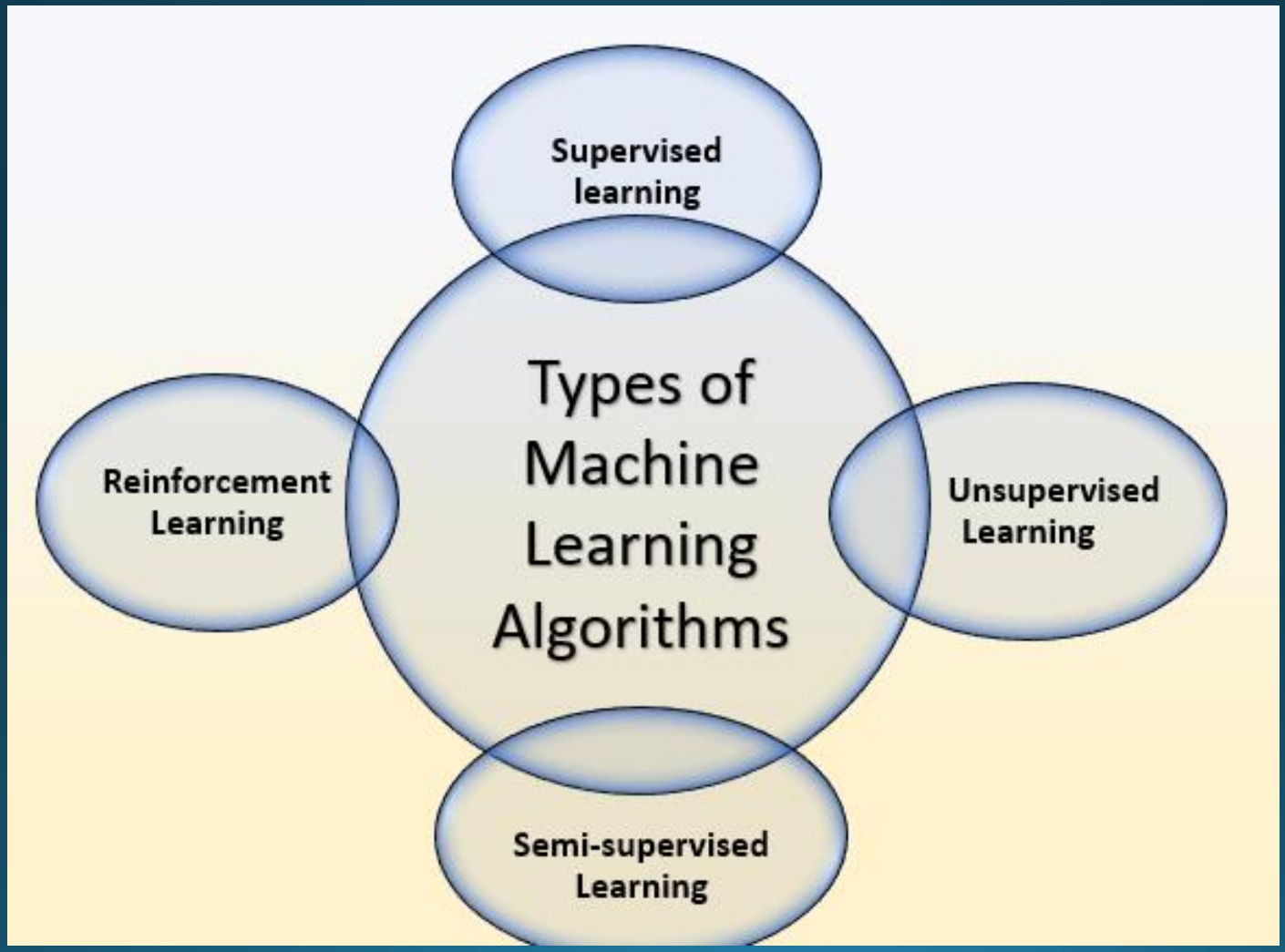
- The goal is to improve access, quality, affordability, equity and justice in healthcare #UHC2030
- AI is not the only way there but will surely be needed
  - The developing world has limited health infrastructure and needs to increase health services beyond limited skilled manpower
  - The developed world has advanced health infrastructure and large healthcare forces, but sustainability is a challenge due to a graying population

Fundamentals of AI-Health 2:
II and IA come before AI

- IA: Computation and data used to create services that augment the functional capacity of intelligent beings
- II: The web of physical entities that generates data and performs computations

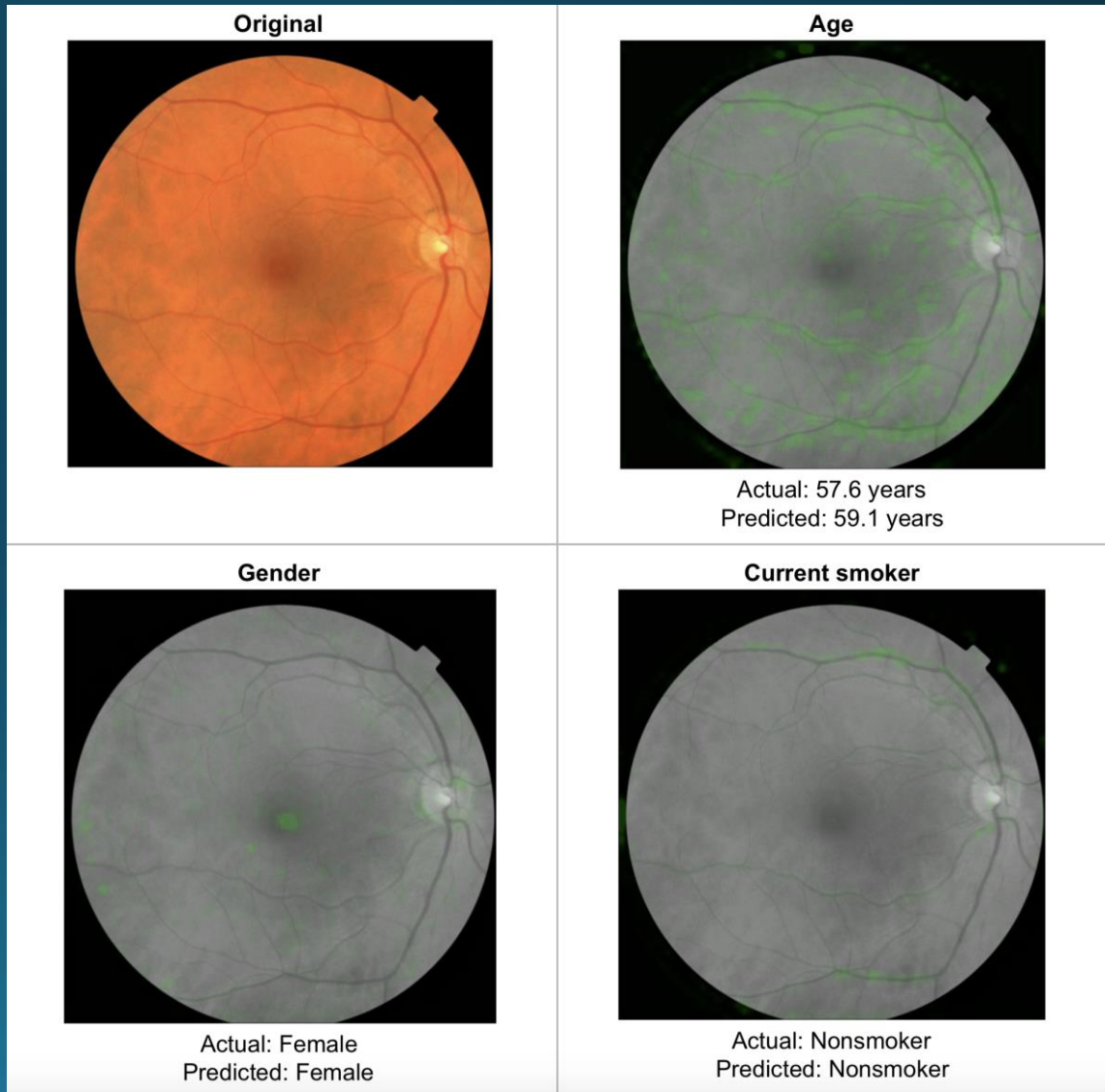
    - II and IA can handle most of the definable tasks in healthcare & its governance without getting into human-imitative AI, which is still some distance away

Fundamentals of AI-Health 3:
AI is ML for current practical purposes



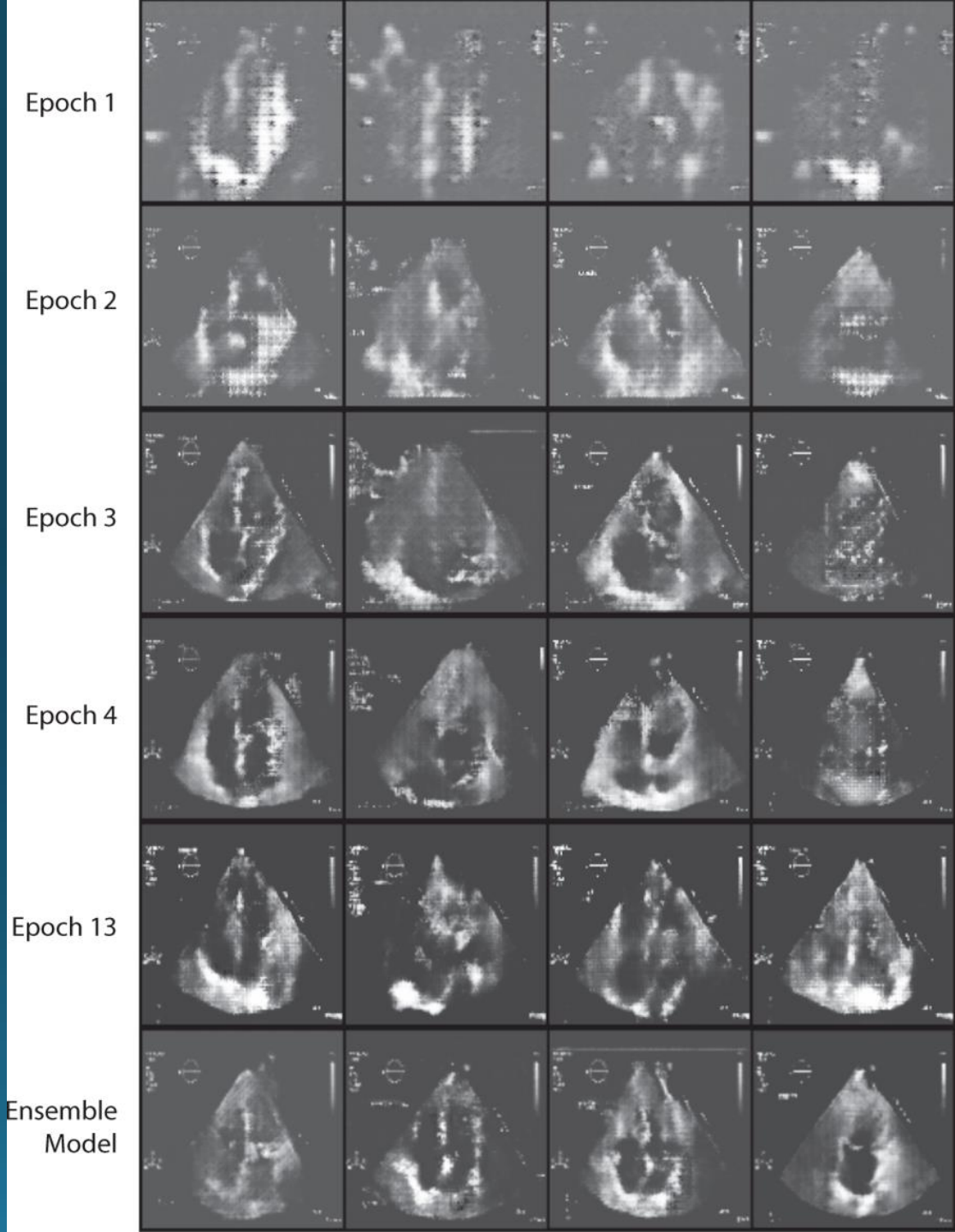
Verily : Truly Eye Opening

- Retina
  - Age
  - Gender
  - Diabetes
  - Smoker
  - Blood Pressure
  - CV risk



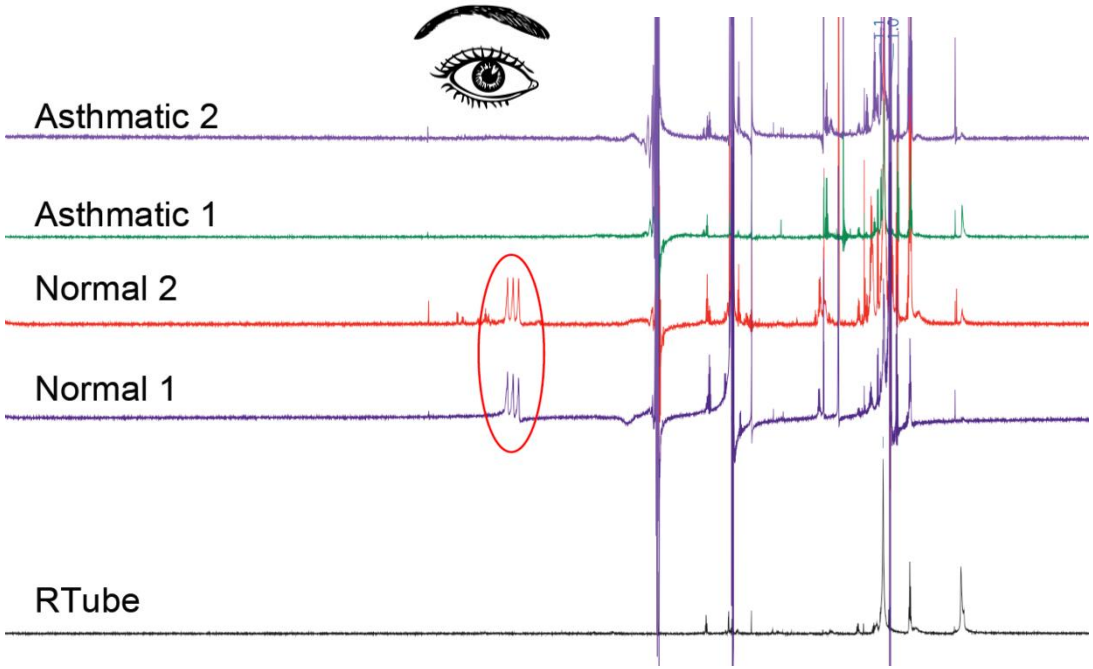
GAN

- Generative Adversarial Networks
- Synthetic images
- Transfer learning



Asthma endotypes:
NMR spectroscopy of exhaled breath condensate

- NMR spectra of EBC



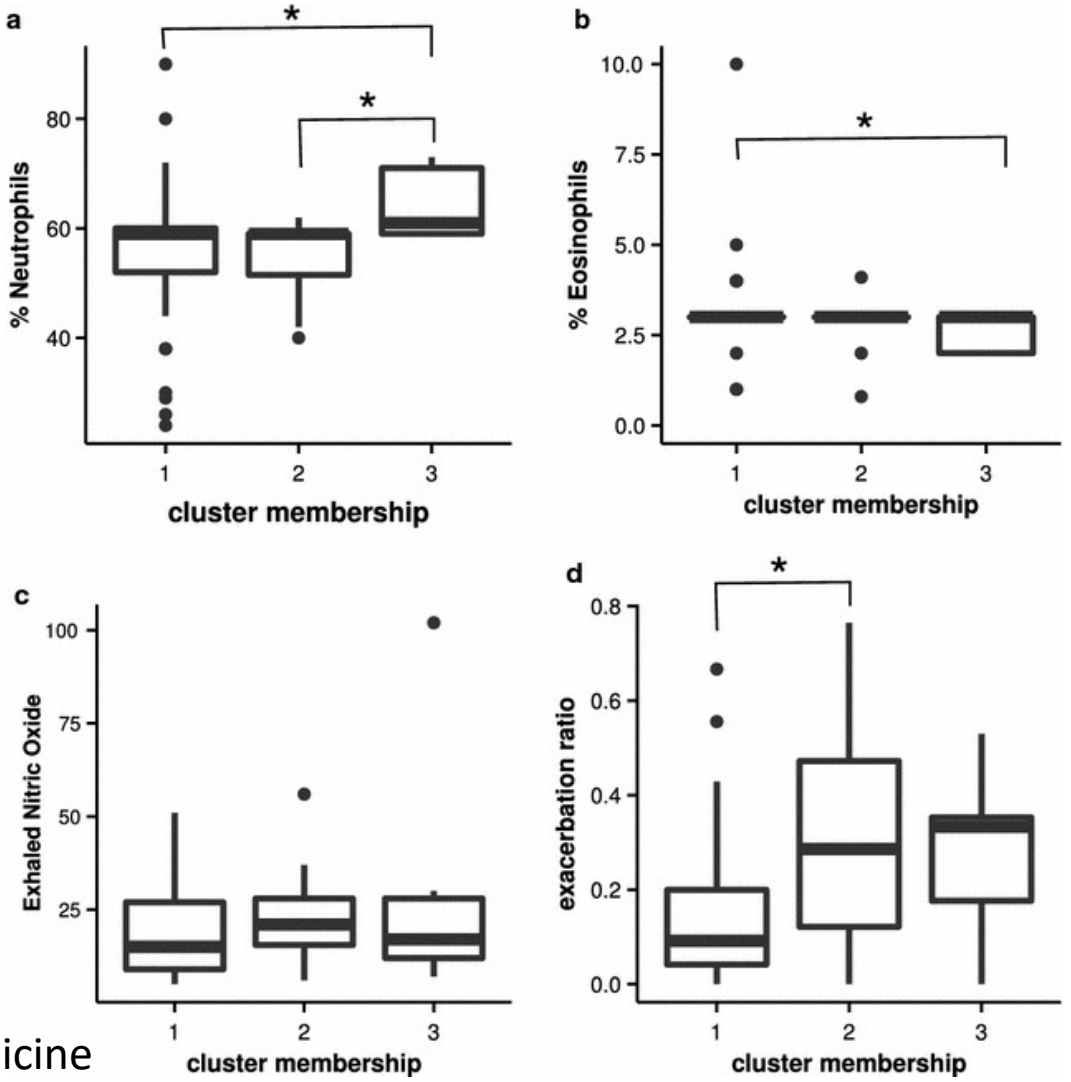
Metabolomic studies of EBC appear useful. Examination of spectra by eye is limiting

European Respiratory Journal, February 2012.

Subphenotype Discovery

- C1 had low exacerbation risk
- C3 had neutrophilic phenotype

Sinha, Desiraju et al, J Translational Medicine



Prescriptive

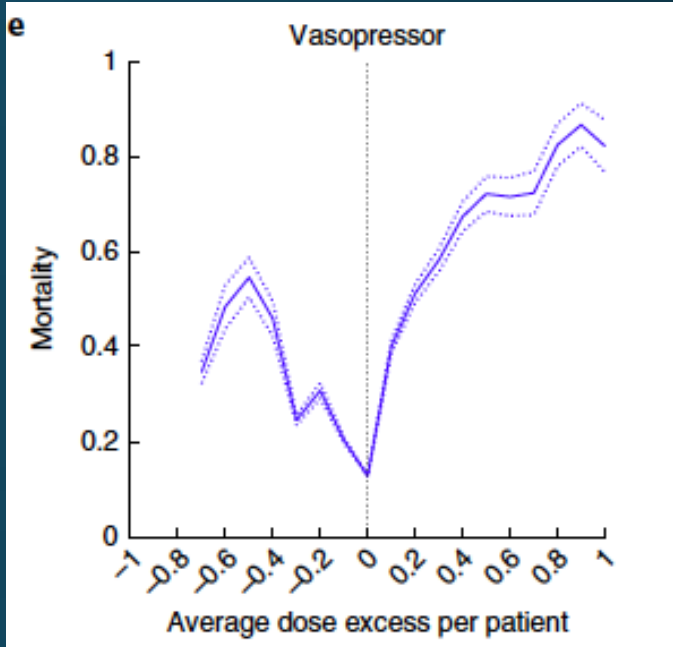
ARTICLES
https://doi.org/10.1038/s41591-018-0213-5
nature medicine

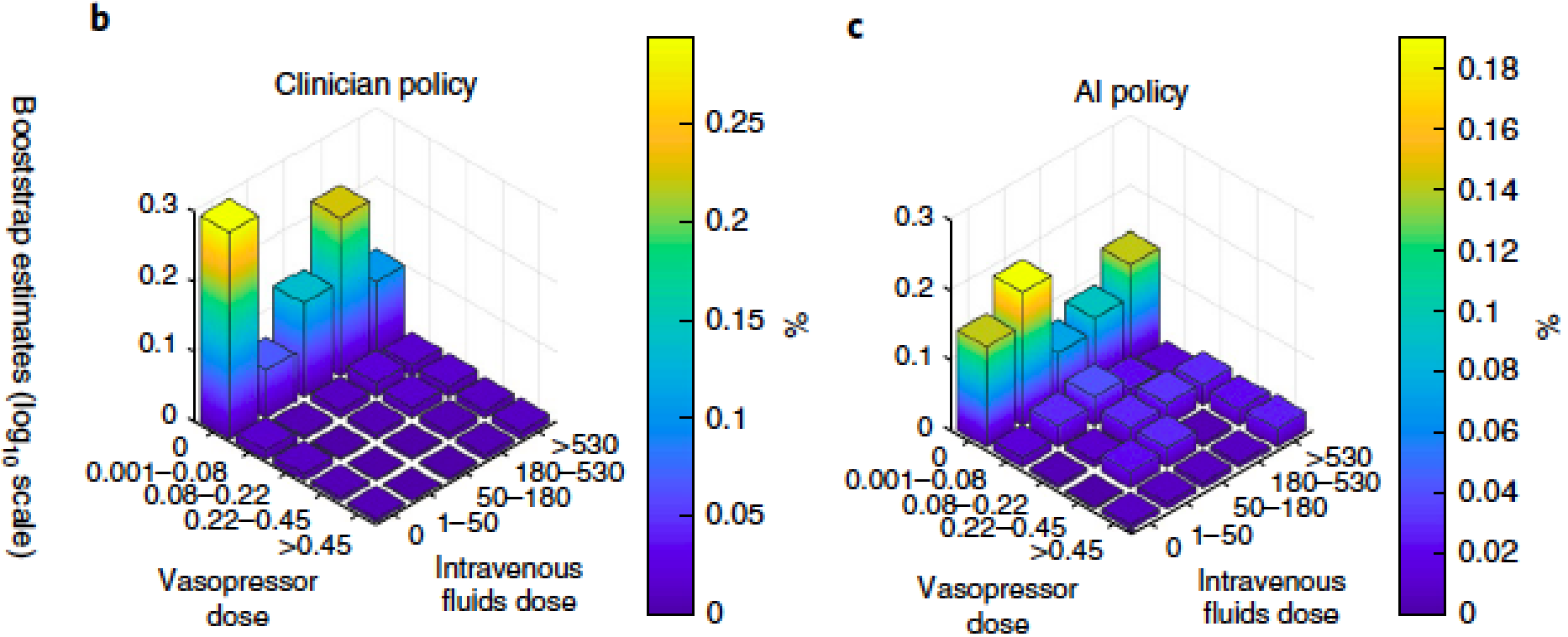
The Artificial Intelligence Clinician learns optimal treatment strategies for sepsis in intensive care

Matthieu Komorowski[1,2,3], Leo A. Celi[3,4], Omar Badawi[3,5,6], Anthony C. Gordon[1*] and A. Aldo Faisal[2,7,8,9*]

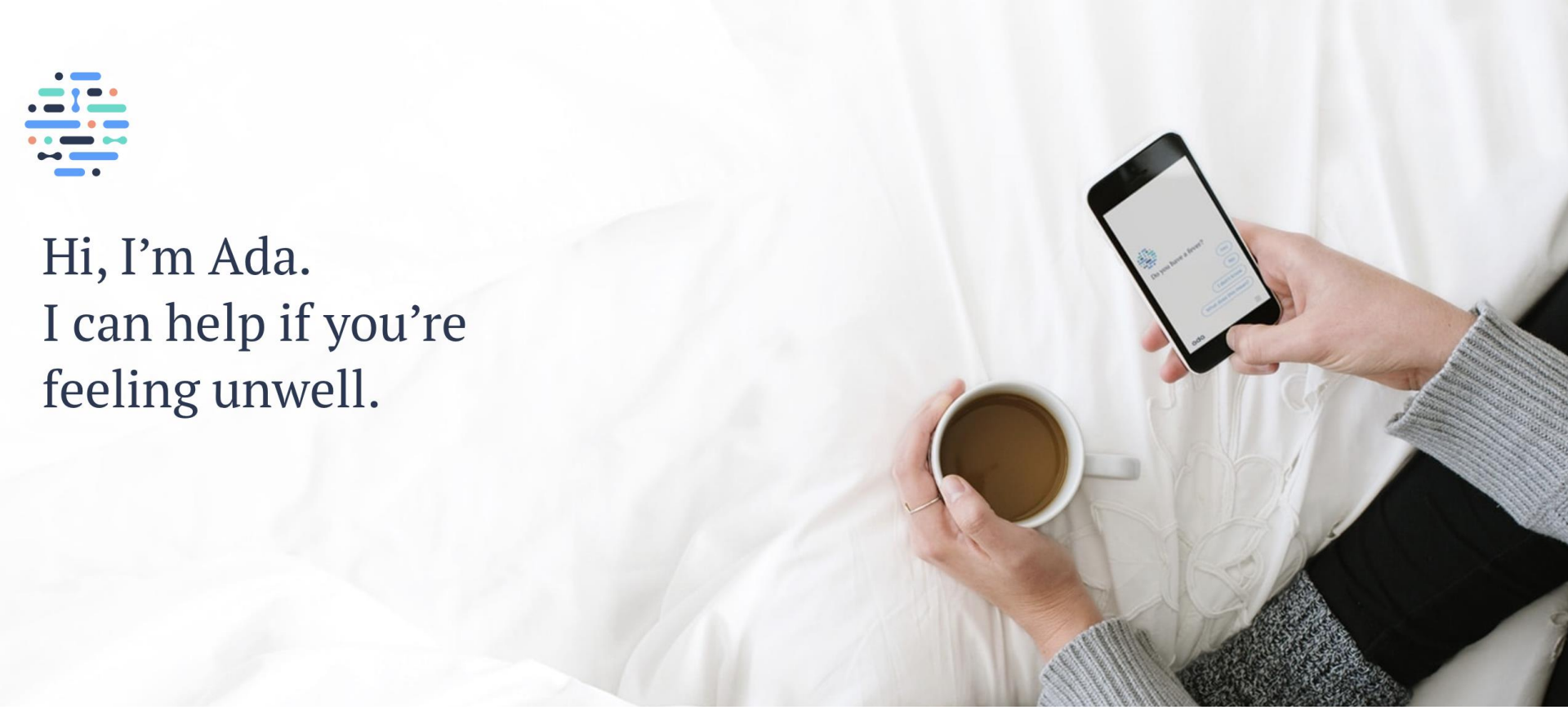
Management of sepsis is complex in possible influences, simple in decision possibilities, very suitable for Reinforcement Learning

Early individualized use of Vasopressors





Hi, I’m Ada.
I can help if you’re feeling unwell.



UK

“Brilliant - the app reported my son could have scarlet fever and it turns out he does have exactly that. Great app will use again.”

★★★★★

Australia

“Recommend!!! This is one of the best apps of all time it is so helpful!”

★★★★★

USA

“This app actually helped my doctor know what's wrong with my shoulder. So grateful for it!”

★★★★★

What can AI/ML/IA do that a human can't ?

- Work tirelessly 24/7
- Be available instantly to everybody
- Update itself continuously
- Duplicate itself and grow without aging
- Handle large amounts of information with full attention continuously

Working Memory

Ability to temporarily hold and manipulate information for cognitive tasks

Can hold 5 - 7 items at once
Depends on attention and mental effort

The NEW ENGLAND JOURNAL of MEDICINE

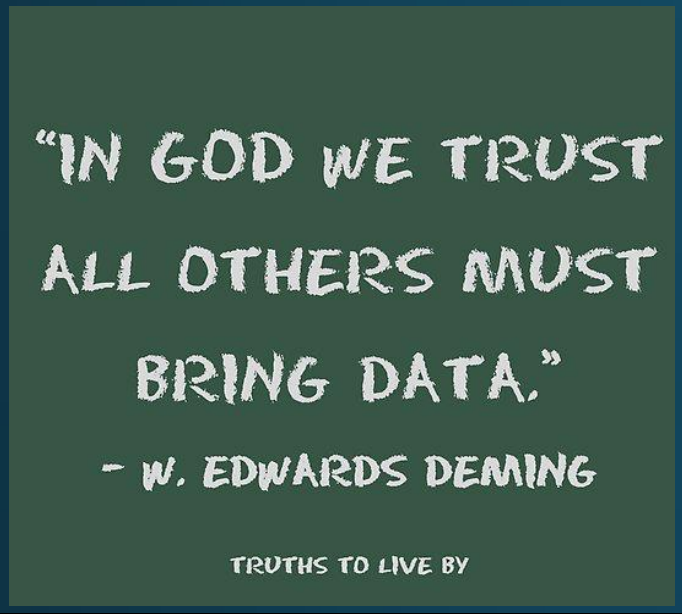
Lost in Thought — The Limits of the Human Mind and the Future of Medicine

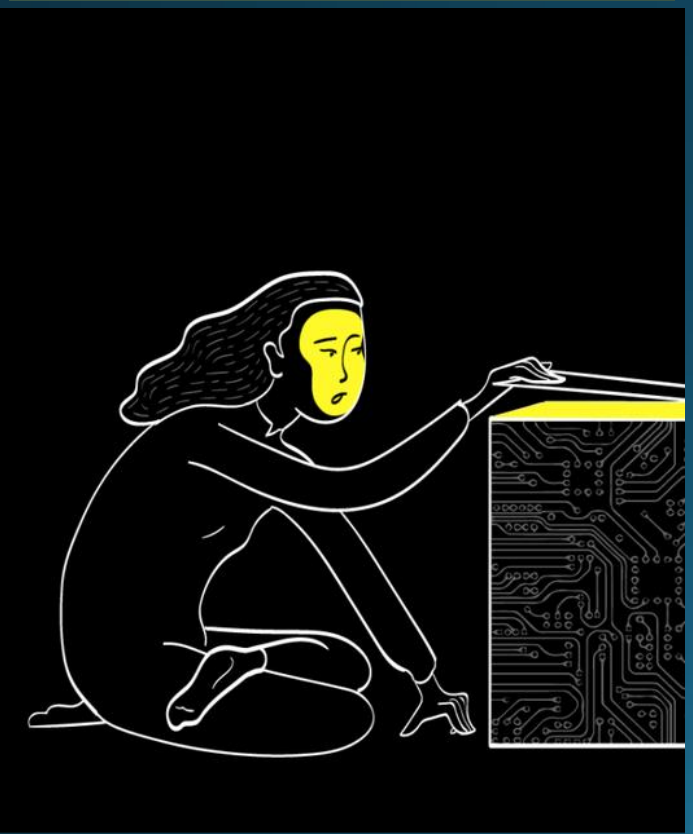
Ziad Obermeyer, M.D., and Thomas H. Lee, M.D.

It's ironic that just when clinicians feel that there's no time in their daily routines for thinking, the need for deep thinking is more urgent than ever. Medical knowledge is expanding rapidly, with a widening array of therapies and diagnostics fueled by advances in immunology, genetics, and systems biology. Patients are older, with more coexisting illnesses and more medications.

ing sent home.[2] Overall, we provide far less benefit to our patients than we hope. These failures contribute to deep dissatisfaction and burnout among doctors and threaten the health care system's financial sustainability.

If a root cause of our challenges is complexity, the solutions are unlikely to be simple. Asking doctors to work harder or get





Fundamentals of AI-Health 3: *In data we trust – maybe?*

- Respect for human autonomy, privacy and ethics are fundamental to healthcare; none are algorithm-based
- Unbiased collection of biased data does not eliminate bias
- Activation maps tell you where AI is looking, not what it sees

Are we past the hype?

- Yes
  - Reaching or exceeding human capacity in healthcare tasks
  - Digital transformation in non-health industries is evident
  - Complex health data handling capacity is beyond human limits
  - AI simply works
- No
  - Healthcare is greater than the sum of specific health tasks
  - Clear examples of outcome improvements lacking
  - Only humans have generalizable understanding
  - Yes, but not trustably

Governing health futures 2030: growing up in a digital world—a joint *The Lancet* and *Financial Times* Commission

A new joint The Lancet and Financial Times Commission focused on the convergence of digital health, artificial intelligence (AI), and universal health coverage (UHC) has been launched

(*Ilona Kickbusch and Anurag Agrawal co-chairs)*

The Lancet, Oct 2019