

Artificial Intelligence (AI), Intelligence Augmentation (IA), and Intelligent Infrastructure (II): Towards better Healthcare & Governance:

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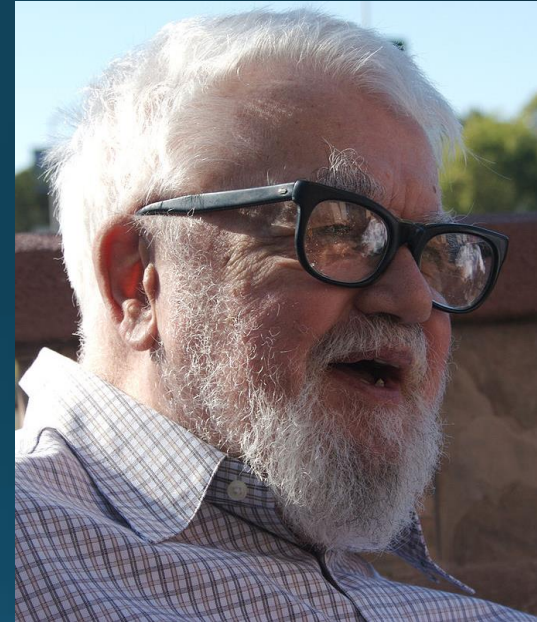
Director, CSIR Institute of Genomics and Integrative Biology

What is AI?

- **Artificial intelligence:** Computer technology concerned with making machines carry out work in an intelligent way, similar to a human
- **Machine learning** gives computers the ability to learn without being explicitly programmed. Algorithms that can learn from and make predictions on data
- **ML** is the most successful approach to **AI**, but not the only approach

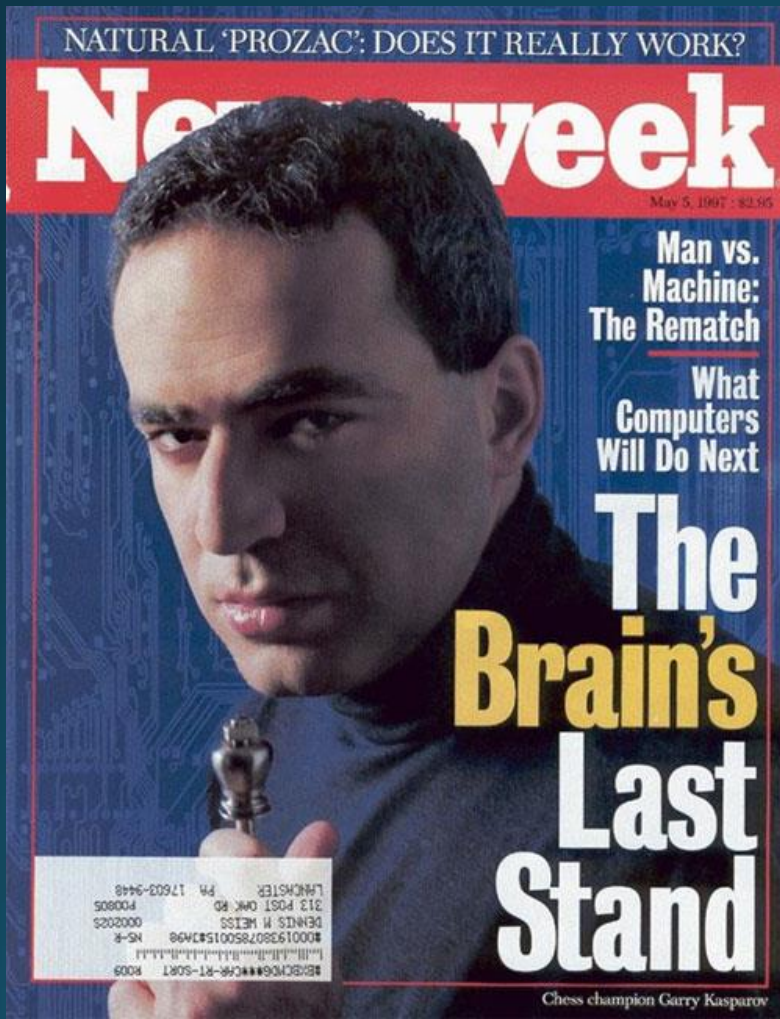
Artificial Intelligence is not new

- Concept older than we think. Traced back to 1950s
- Preceded by Cybernetics, which was essentially the same thing with a focus on pattern recognition rather than logic



John McCarthy

Towards AI: Deep Blue to Deep Mind



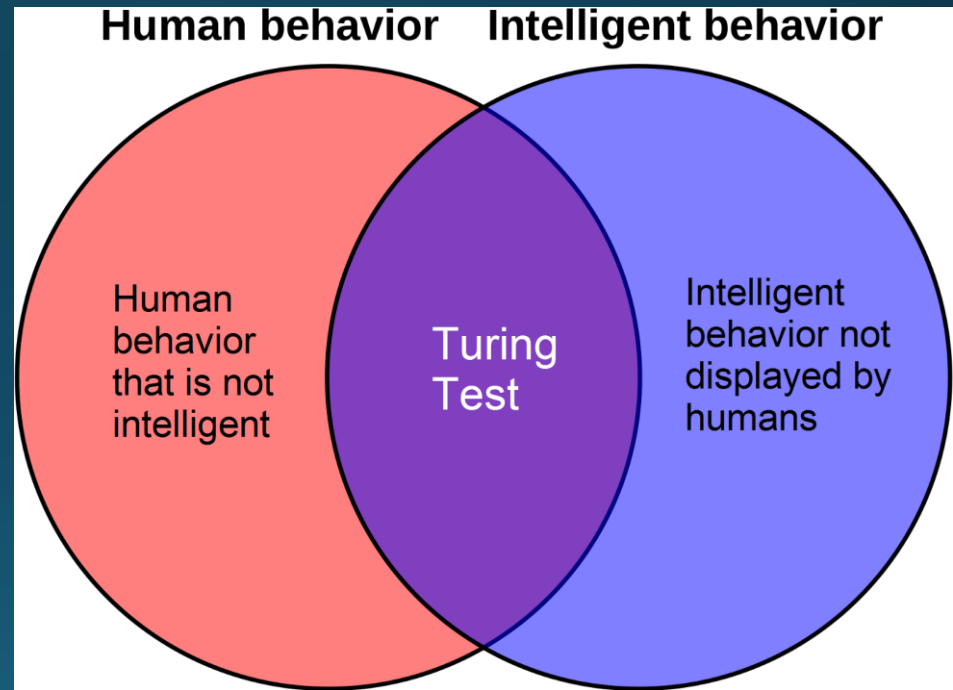
The New Kid on the Block - 2017



AlphaZero beating Stockfish 64-36-0 after just four hours of self-training shocked the chess world

So, does the AI understand?

- It learns to
 - Describe
 - Classify
 - Predict
 - Strategize
- But no it doesn't "Understand"



What can AI/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

Intelligence Augmentation (IA) and Intelligent Infrastructure (II)

- 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 governance without getting into human-imitative AI, which is still some distance away

Major Classes of applications

- Descriptive (II/IA)
 - Gathering and collation of data with pre-defined alerts or actions
 - tuberculosis cases in a region being mapped to households for surveillance
 - monitoring spending patterns
 - Communication using NLP
- Classification (IA/AI)
 - Diagnosis using computer vision or other types of machine learning on annotated data
 - Tuberculosis CxR
 - Automatic identification and import of unlabeled data
- Predictive (AI)
 - Modeling of risks and likelihoods
 - Impending health catastrophe – heart attack, epidemic etc
 - Financial risk
- Prescriptive (IA/AI)
 - Interventions based on causal understanding

AI-aided Governance Utopia

- Human job like a Tesla driver



Reality: Increased productivity, with focus on
human interactions
(Treating disease to healing patient for Doctors)



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



A Glimpse of the Next 100 Years in Medicine

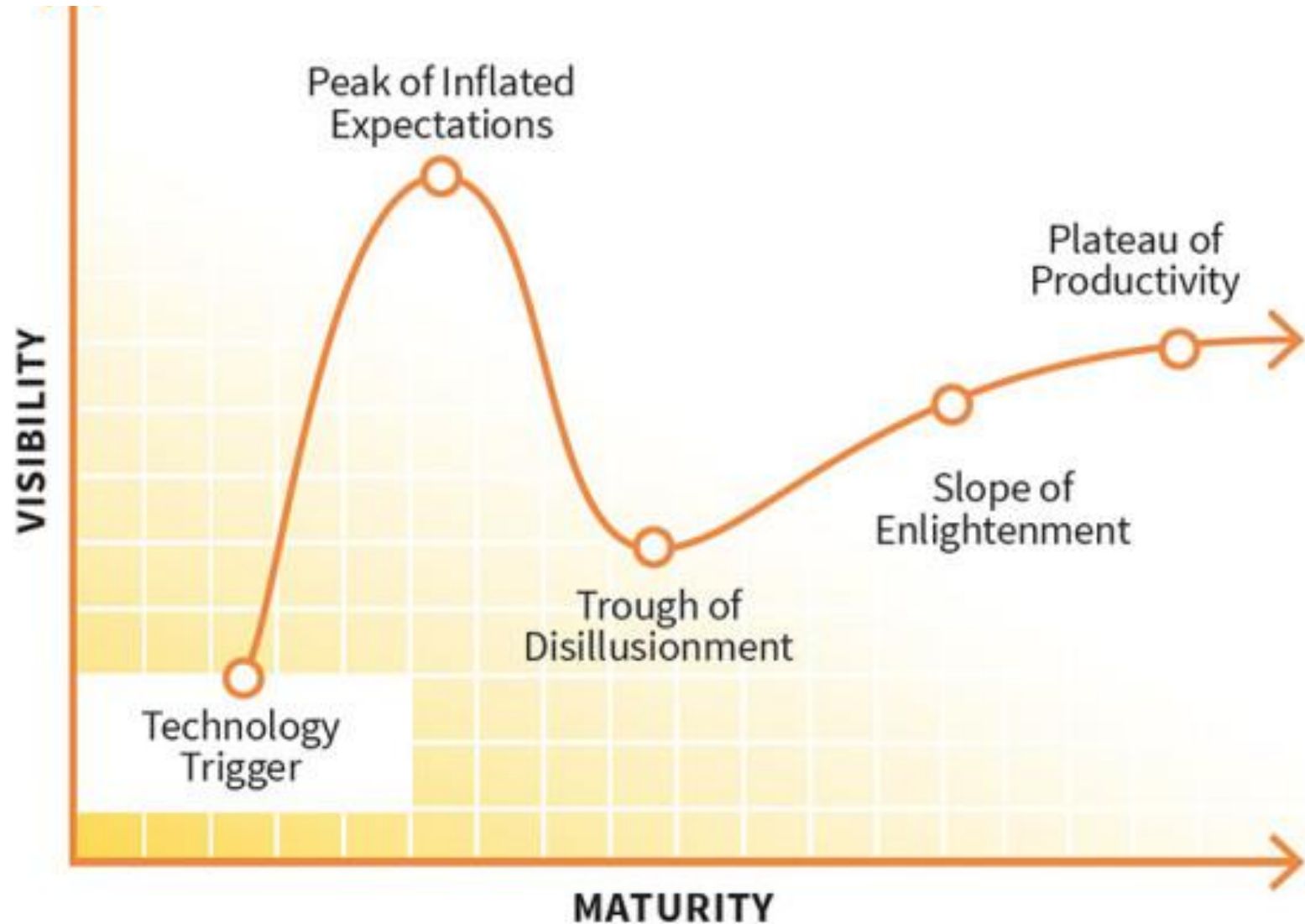
Isaac S. Kohane, M.D., Ph.D., Jeffrey M. Drazen, M.D., and Edward W. Campion, M.D.

monitoring instruments will continue to become smaller, smarter, more interactive, and more connected to the health information infrastructure. However, the quantum leaps will come not from the devices but from inferences drawn from the data.

The size and complexity of this multidimensional characterization of patients will lead to far more complex diagnostic and prognostic categories than are currently in use. The multivariate descriptors of large populations will allow stratification of a kind seen only in the most recent genomically informed clinical trials.² Massive data crunching will yield analytic or algorithmic formulas that will be useful for clinical purposes even though they defy easy summary in a language most of us can understand. Complex but

Machine Learning and Prediction in Medicine — Beyond the Peak of Inflated Expectations

Jonathan H. Chen, M.D., Ph.D., and Steven M. Asch, M.D., M.P.H.



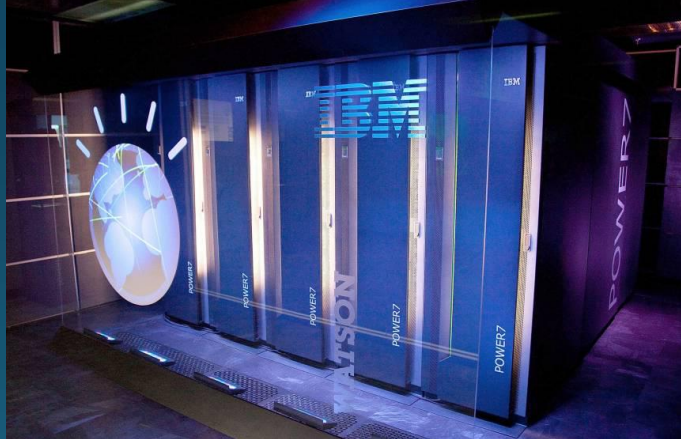
What have been the main changes in the last few years that have led to discussions about computers as a viable alternate to humans?

Dr. Computer: Is it a reality?

Precision Medicine

IBM Watson pinpoints rare form of leukemia after doctors misdiagnosed patient

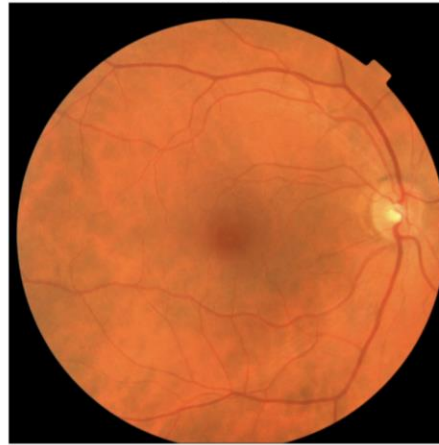
The supercomputer identified a different type of cancer than the one doctors were currently treating for a patient in Japan.



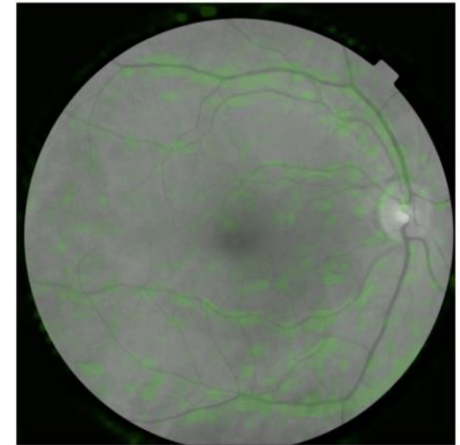
Verily : Truly Eye Opening

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

Original

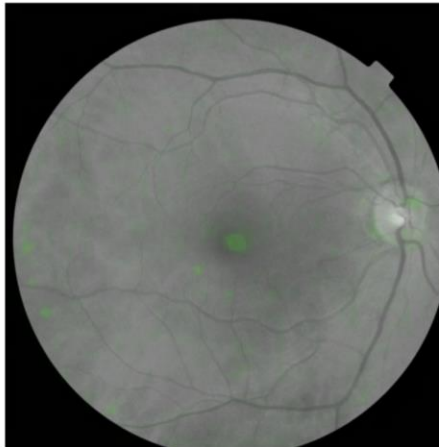


Age



Actual: 57.6 years
Predicted: 59.1 years

Gender



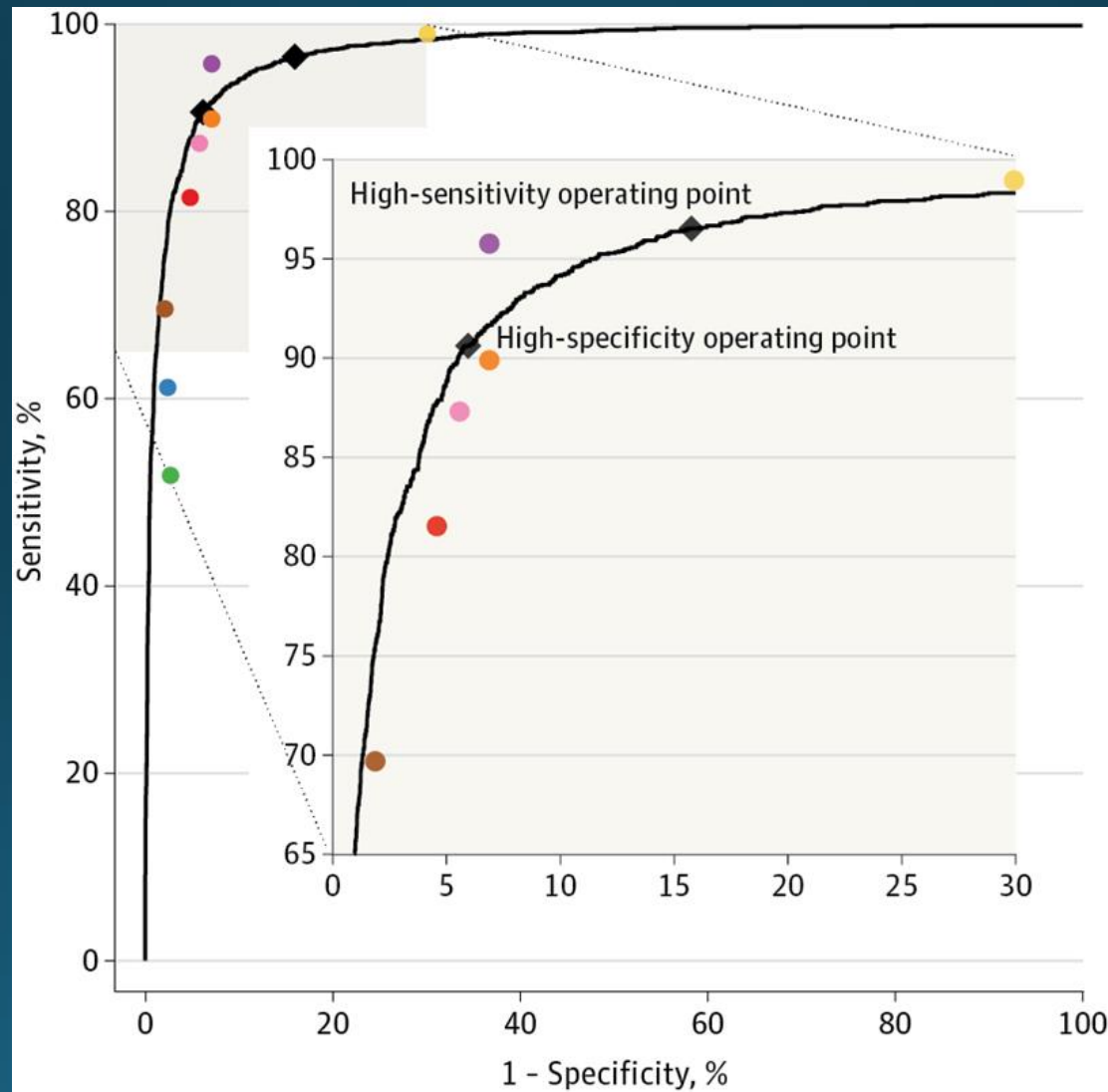
Actual: Female
Predicted: Female

Current smoker



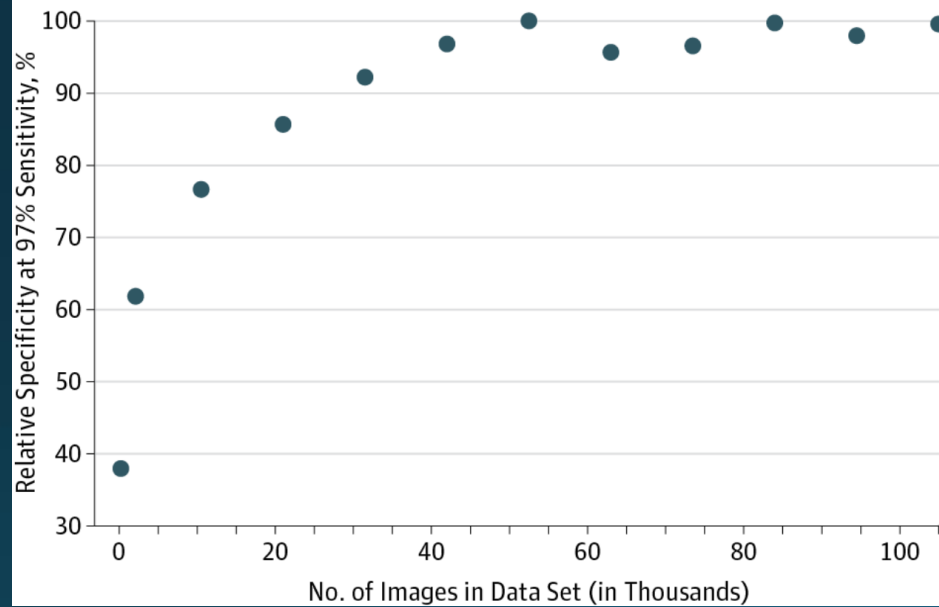
Actual: Nonsmoker
Predicted: Nonsmoker

Detecting Diabetic Retinopathy to Prevent Blindness

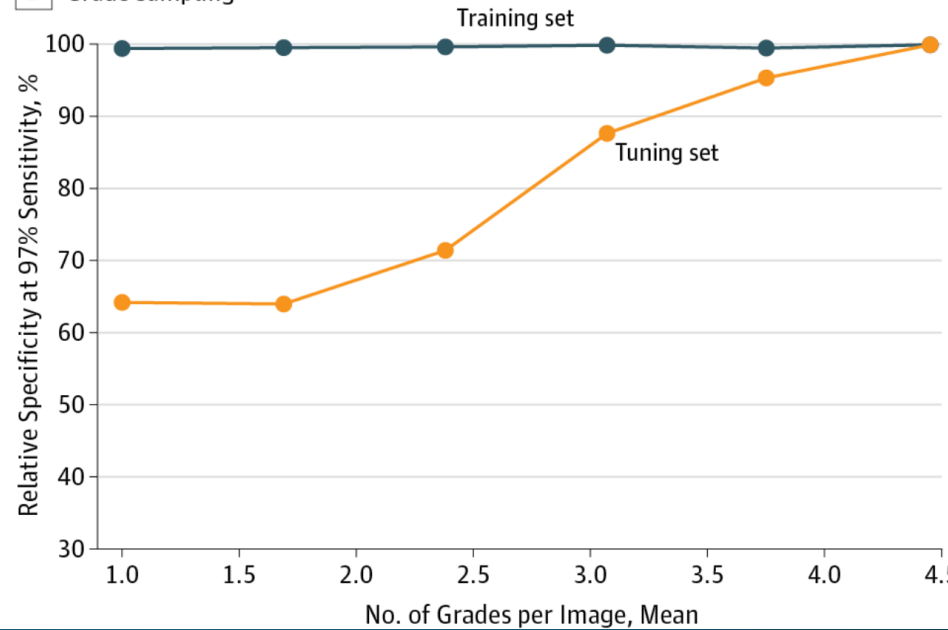


It takes a lot of data

A Image sampling



B Grade sampling





The children have been followed up for five years now says Koundinya Desiraju.

The algorithm has 80% sensitivity and 75% specificity in identifying childhood asthma

Using machine learning, a field closely related to artificial intelligence, upon nuclear magnetic resonance (NMR) spectra of exhaled breath condensate, Delhi-based researchers have been able to improve the diagnosis of childhood asthma and even identify three asthma subtypes. This pushes the current understanding of childhood asthma towards having metabolomic (study of chemical processes involving metabolites) subtypes, which have been largely unknown so far.

MEET THE DUKE SENIOR WHO CREATED A CANCER-DETECTING APP IN HIGH SCHOOL

Believe it or not, after winning the Google Science Fair with her invention, Brittany Wenger is up to even more impressive research today.

BRITTANY WENGER

15 YEARS AGE:

USED PUBLIC DATA TO
CREATE A BREAST CANCER
ALGORITHM FROM GENE
EXPRESSION DATA

CLOUD4CANCER



How will AI change Healthcare?

THE CREATIVE DESTRUCTION OF **MEDICINE**



ERIC TOPOL, M.D.

Potential game-changers

- Minimizing the impact of low Physician to Patient ratio
- Shift from hospitals to homes as point of contact
- Shift from episodic encounters to continuous surveillance and recording by wearable devices and home monitors
- Natural language processing to extract more value from patient-physician interaction
- Shift from electronic medical records to personal health records

So what could a AI enabled robot physician do

- See
- Hear
- Take history
- Place sensors and obtain readings
- Perform chemical analysis
- Interpret the data
- Provide Advice



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!”



Natural Language Processing

Robot Surgeons?

- Not yet, maybe in a decade



**“We Didn’t Do
Anything
Wrong, But
Somehow, We
Lost”**

***Steve Ballmer,
Nokia CEO***

Imperatives for India

- Shortage of healthcare workers
 - Doctors less than WHO recommended minimum of 1:1000 population
 - Worse in rural areas
- Leaky system with poor workflow
- Lack of technology driven processes that permit timely insights and action
- First step is to build the intelligent infrastructure

Health in Action

Integrating Health Care Delivery and Data Collection in Rural India Using a Rapidly Deployable eHealth Center

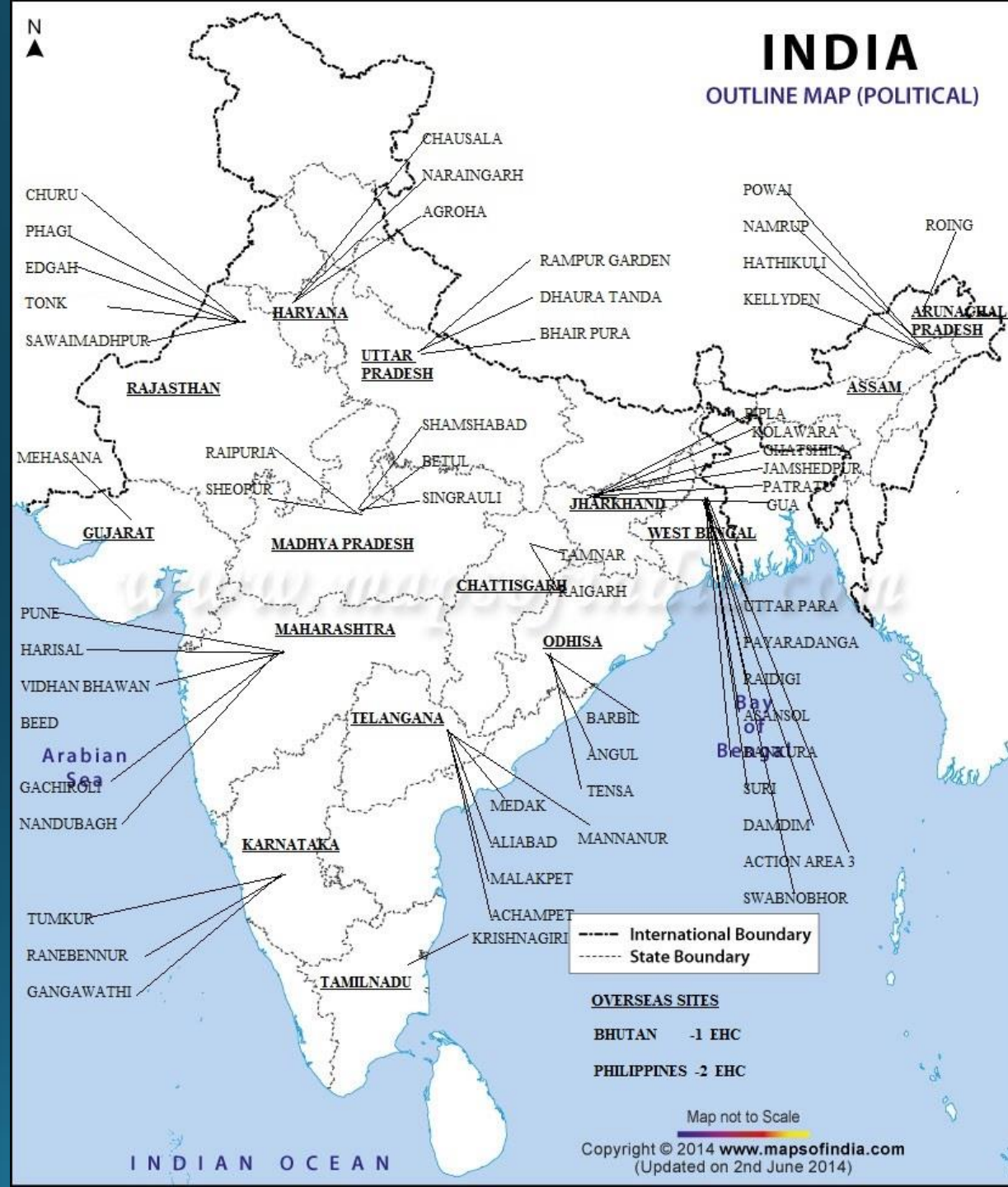
Anurag Agrawal^{1*}, Jaijit Bhattacharya², Nishant Baranwal³, Sushil Bhatla², Salil Dube⁴, Viren Sardana⁵,

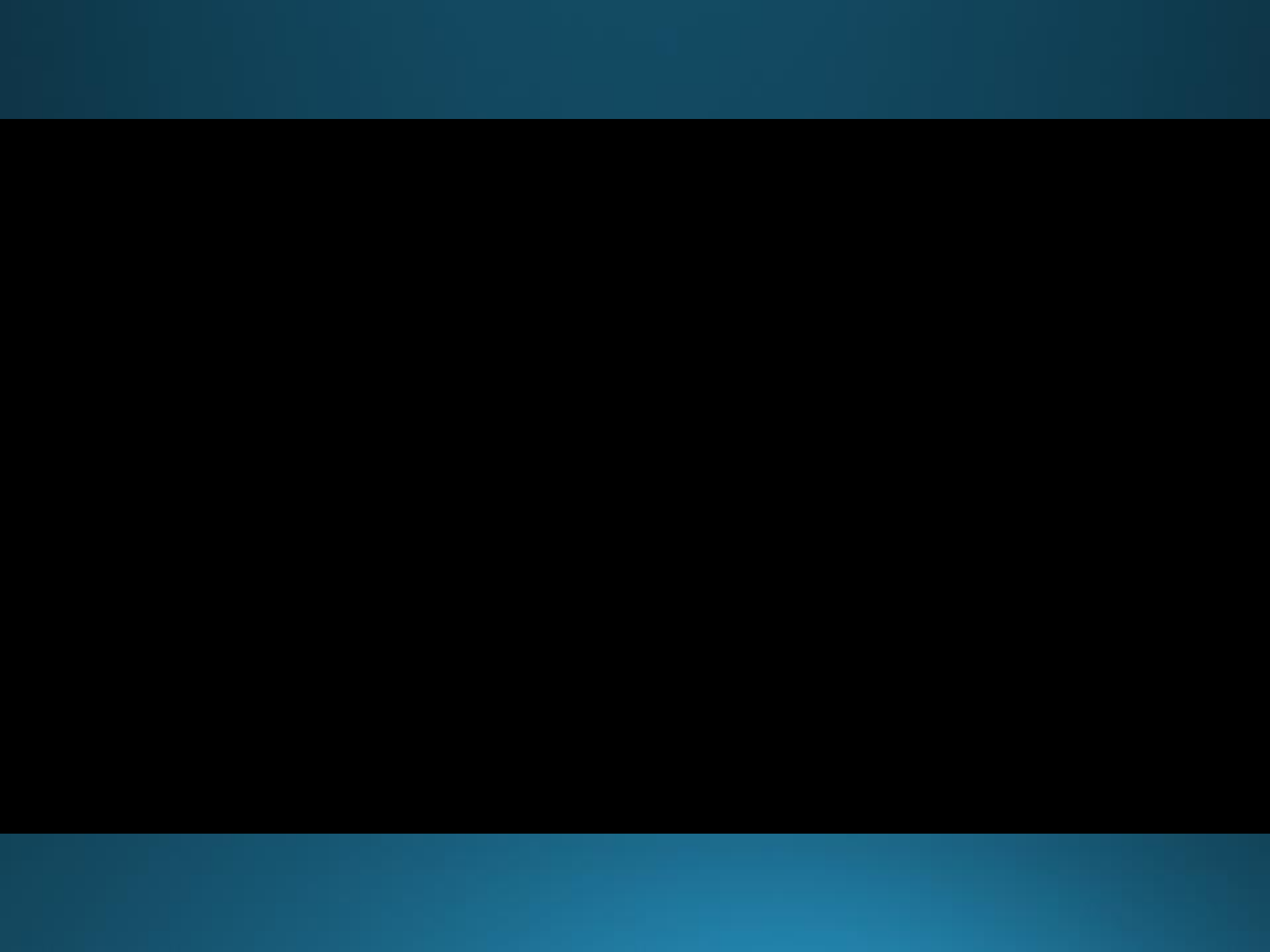


Integrated health centre in a deployable container with cloud based workflow and telemedicine capacity

Pan-India Presence

5 lakh patient visits
All data on cloud





Could IA/AI help?

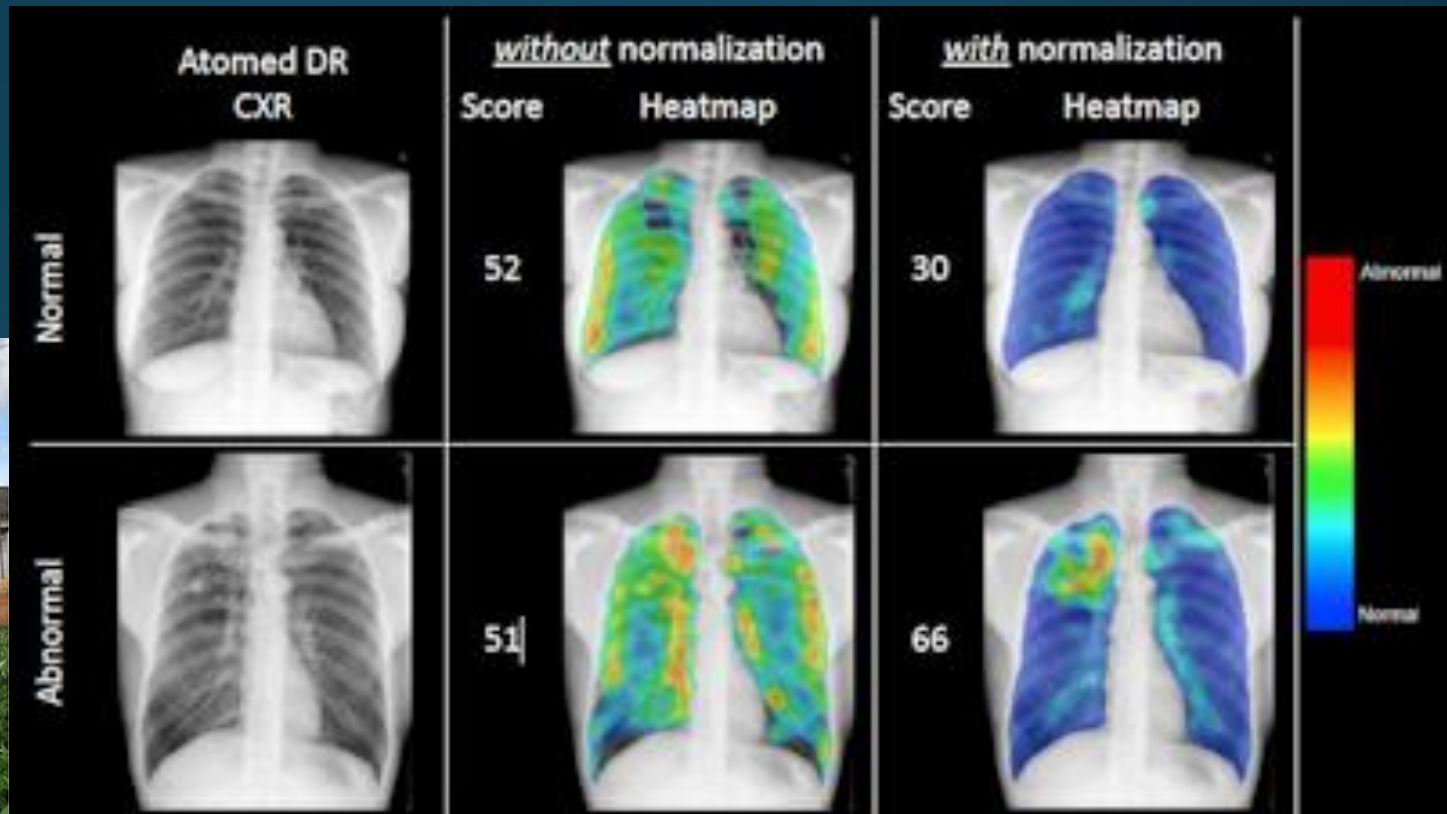
- Descriptive applications with human-defined alerts or interventions
- Workflow assistance by automating routine activities
- Cannot handle free text easily yet
- Startups are forming
 - iCHR
 - Trackmybeat

Strengths

- Classification problems are generally solvable
 - Machine learning can handle most image based diagnosis problems quite well
 - Startups: SigTuple (pathology), Niramai (Breast Thermography)

Machine Learning in Radiology

- Computer Aided Diagnostics for TB (CAD₄TB)
 - Comparable to human doctors in Africa
 - Being tuned for Indian patients

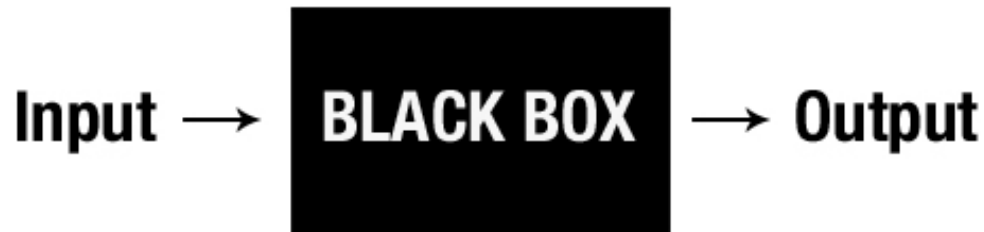


Strengths

- Prediction problems are becoming better for specified conditions
 - Need India specific data to be useful

Limitations

- Open diagnosis can be challenging
 - Probabilities of different diseases vary greatly across India but not unsurmountable
- Black box problem
 - Opening the hood not always possible
 - Indian patients may be accepting, but would doctors?



The Challenge

- Need Indian data to train accurate AI systems
 - Severe lack of digital data
 - Severe lack of relevant manpower in AI
- Nations within a nation

ARTIFICIAL INTELLIGENCE TASK FORCE

CONSTITUTED BY MINISTRY OF COMMERCE AND INDUSTRY, GOVERNMENT OF INDIA



Big data in biomedicine

25 – 27 February 2018 | Delhi, India

Suggestions

- Empowered users such as physicians or civil servants form a key stakeholder community for incorporation of AI in medicine or governance
- Exposure and training to understand and seed the movement
- Use case scenarios needed
 - Ayushman Bharat (Modicare) to be implemented leveraging big data and AI
 - With 100 million families / half billion people under the scheme, India will jump to a deserved leader's position

The promise

- AI will impact governance or healthcare quality and services positively
- The spirit of sharing exists and many technologies will be freely distributed
- Regulatory issues are being evaluated and will be the bottleneck
 - Acceptability to consumers
 - Liability in case of error
 - Feasibility of regulatory sandboxes

AI applications are diverse

- Finance - Stock markets, virtual trading
- Commerce – Consumer suggestions
- Manufacturing – Robotics
- Urban planning – Smart Cities
- ? Creative endeavors

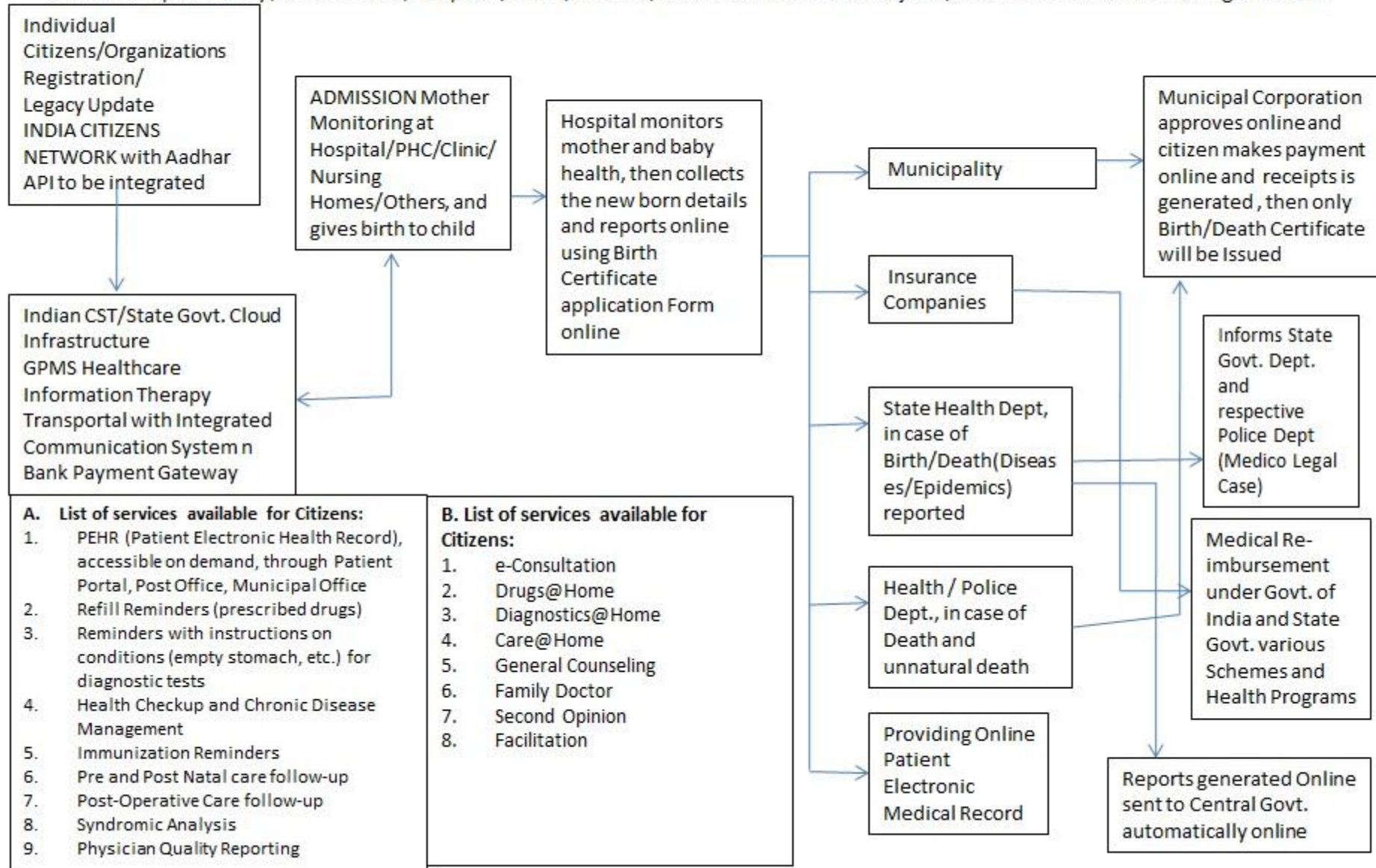


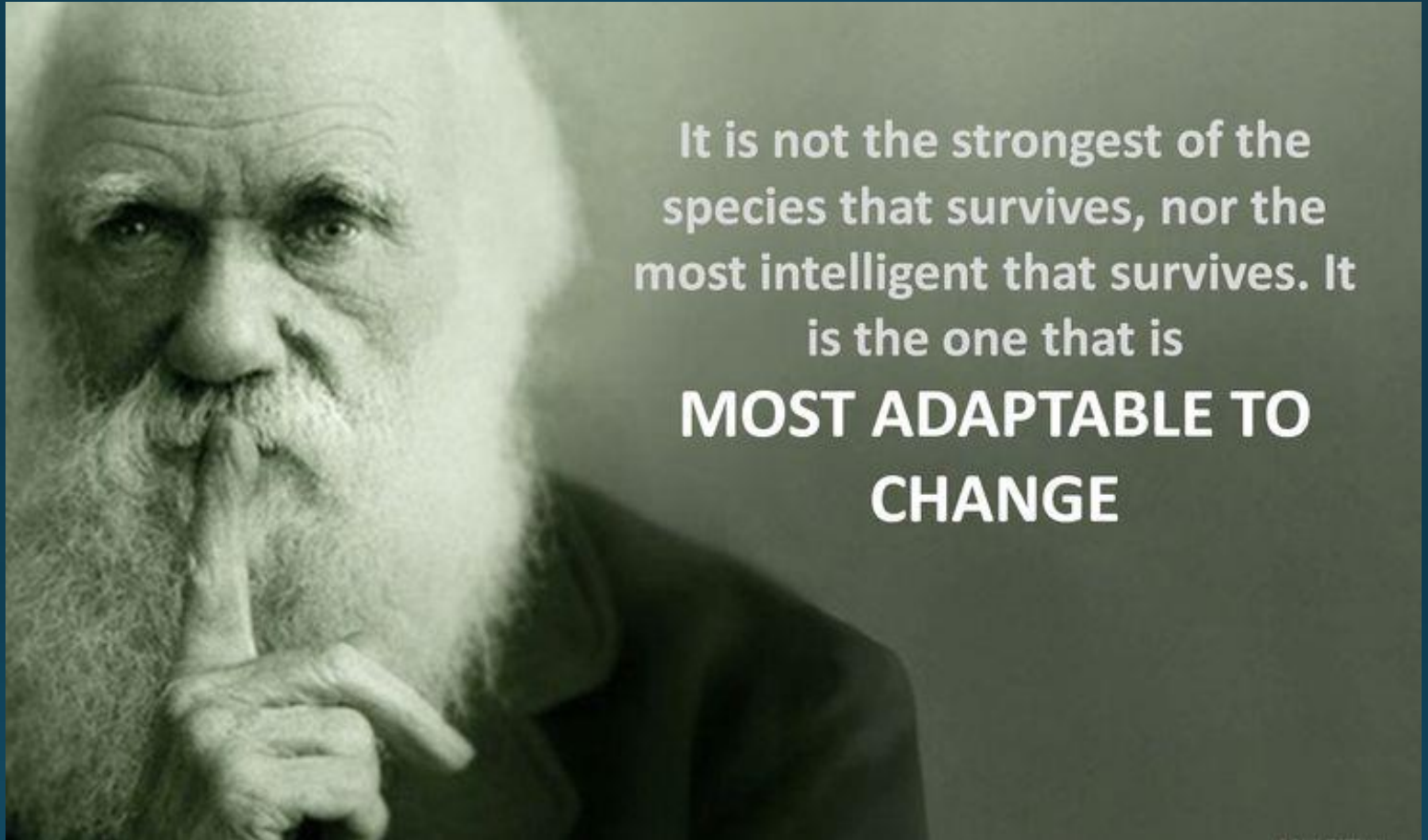
"What do I want? You're the one with the magic powers. Don't you know what I want?"

GPMS Healthcare Information Therapy Transportal

Monitoring of Mother and Child with Citizens Electronic Health Record with all Clinical Parameters

Allows Multiple Ministry / Stakeholders / Hospitals/ PHC's/ Doctors / Associated healthcare Projects / Schemes To Work on This Single Platform





It is not the strongest of the
species that survives, nor the
most intelligent that survives. It
is the one that is
**MOST ADAPTABLE TO
CHANGE**

