IN PURSUIT OF THE PERFECT

W. Ed Hammond, PhD, FACMI, FHL7, FAIMBE, FIMIA, FIAHSI
Duke Center for Health Informatics
Clinical & Translational Science Institute
Duke School of Medicine

Chair Emeritus, HL7 International

The Healthcare System Is Broken!

- Lack of communication
  - Between clinicians
  - Between clinicians and patients
- Lack of interoperability
- Systems are siloed
- Systems are out of date
- Medical errors are the 2nd leading cause of death

Bumps in the road to change

- We assume the barriers that currently exist are here to stay, and anything new we do must fit within those boundaries.
- We spend much of our time and money doing work-around rather than face the true problem.
- We are not willing to attack the really hard problems.
- We tackle today's problems with tools from yesterday.

More bumps

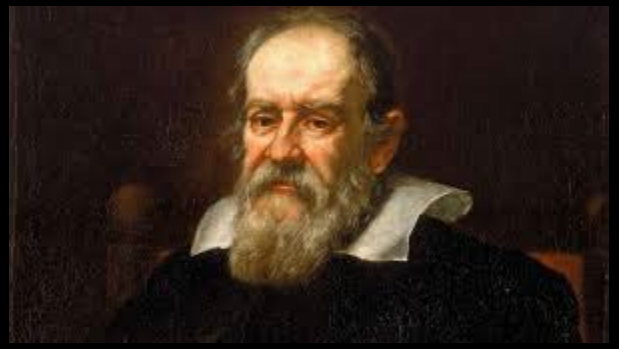
- We focus on a specific problem rather than looking at that problem within a total environment.
- We start with an assumed solution and attempt to solve the problem within the capabilities of whatever solution we have decided to use.
- We never look to see if someone else has solved the problem or are at least currently addressing it.
- You can’t get the perfect system by fixing today’s system.

Life today

- Physician and nurse burnout are prevalent.
- There is no equity in health care today.
- Most popular EHR systems are aged (EPIC – 1976).
- New technology is not being used.
- Reimbursement drives what data is collected and how it is coded. Claims databases are used for observational research.

- How would you define the perfect health system?
- What is involved in defining the perfect health system?
- How might we achieve the erfect system?

What is the Galileo Project?



- The Galileo Project is to define the PERFECT Health System.
- Health Care is a sub-component.
- The goal is not to address perceived problems of today, but to step into the future.
- Invited 24 clinicians to participate to a “thinking aloud” Zoom session on September 10, 2020.
- Can’t say you can’t do that.
- Can’t say that’s impossible.
- We want the perfect system with no constraints.

The first step toward perfect

- Without patients, we would not need a health care system.
- Therefore, patients should be the center piece of the perfect system.
- We must approach every function from that perspective.
- What should we do to provide the most value to the patient.

- **PATIENT FIRST**

Perfect - for the patient

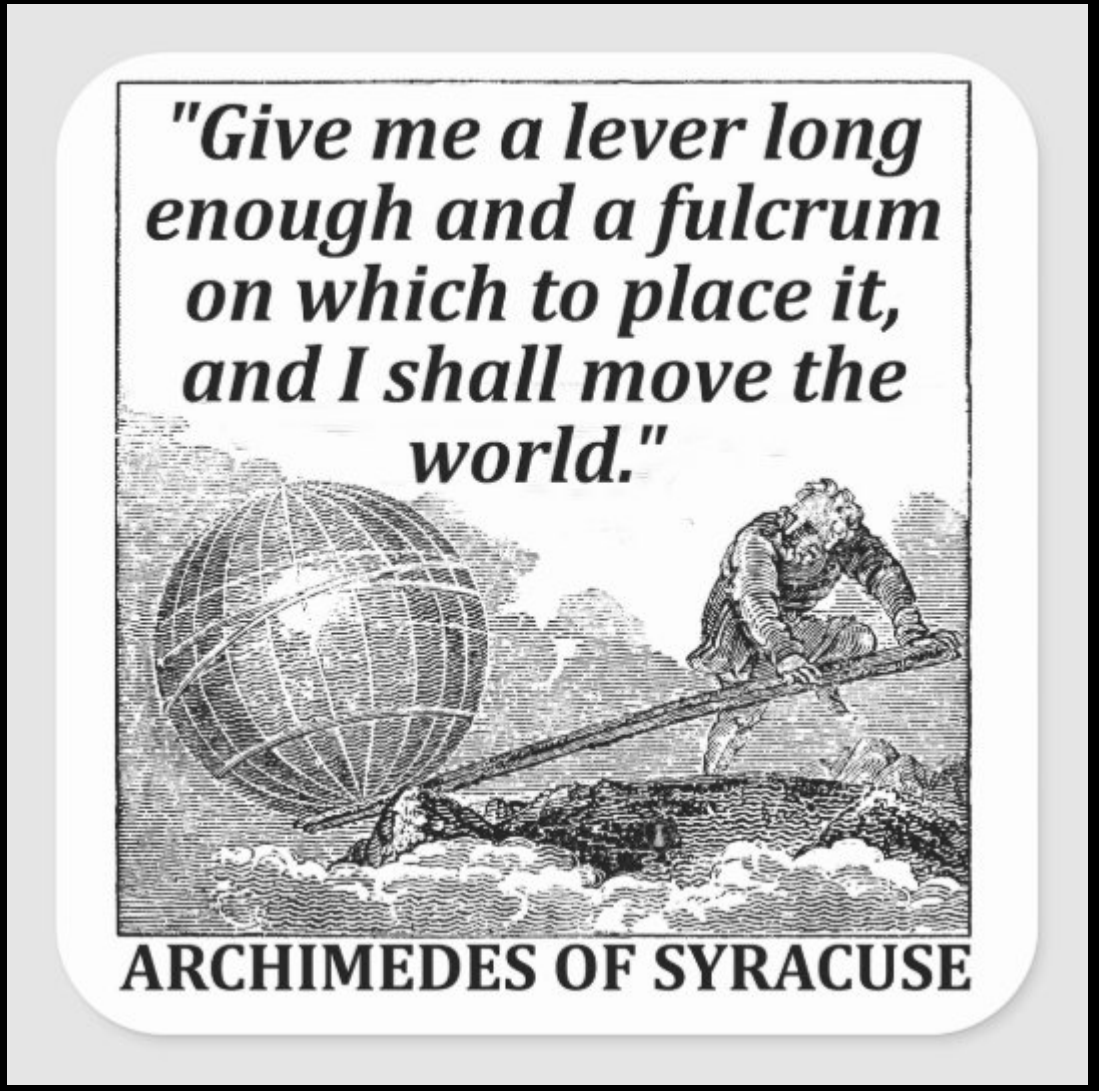
- There must be equity in health and health care.
- Access to care – whenever and wherever it is needed
- Service rendered cannot be influenced by what the insurance will pay but what is needed
- The appropriate medicine or treatment must be available to every person
- Health literacy is essential, therefore taught

More for the patient

- Patient navigation of the system should be enabled.
- Bring clinicians to patient, not patient to clinician.
- Mental Health should be an equal service.
- Virtual visits
- Home hospitalization whenever possible
- Once health system accepts a patient, it should accept full responsibility for that person

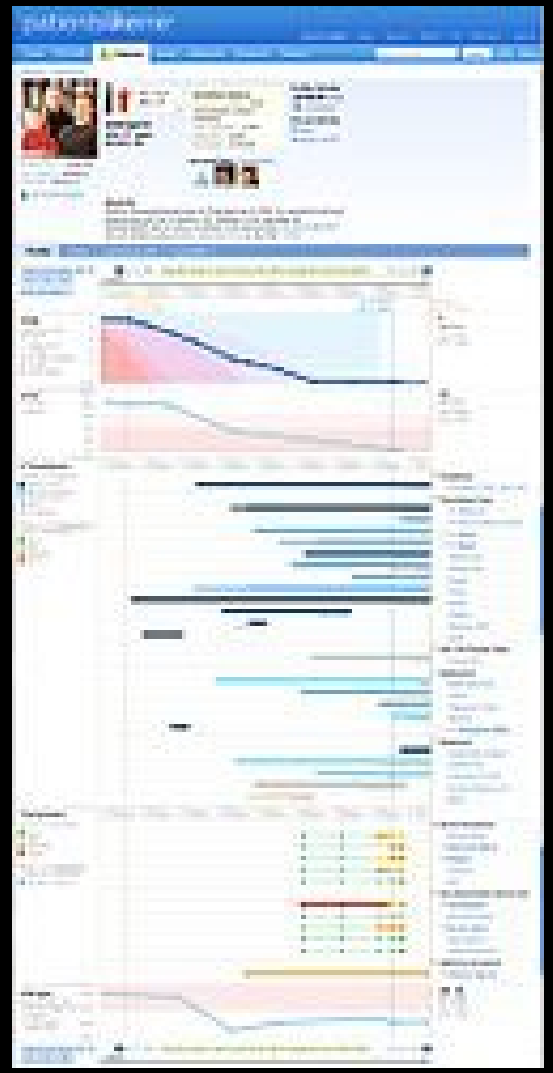
The Archimedes Project

- Collect comments from patients of “bad” things that have happened to them in the health care environment.
- Use NLP and data analytics to classify comments.
- Design the perfect system to resolve all these issues.
- Patients are the lever to push acceptance of the perfect health system.



New Voices …

- Patients, consumers, citizens or what ever we wish to call them are have an influence in health and health care.
- “Googling” has opened the knowledge and understanding of disease for the non-professional to change the communication between physician and patient.
- Shifting care outside traditional settings
- Data collected and analyzed in real time becomes more responsive.
- Patients want to push this data back into their EHR.



Patient Communication

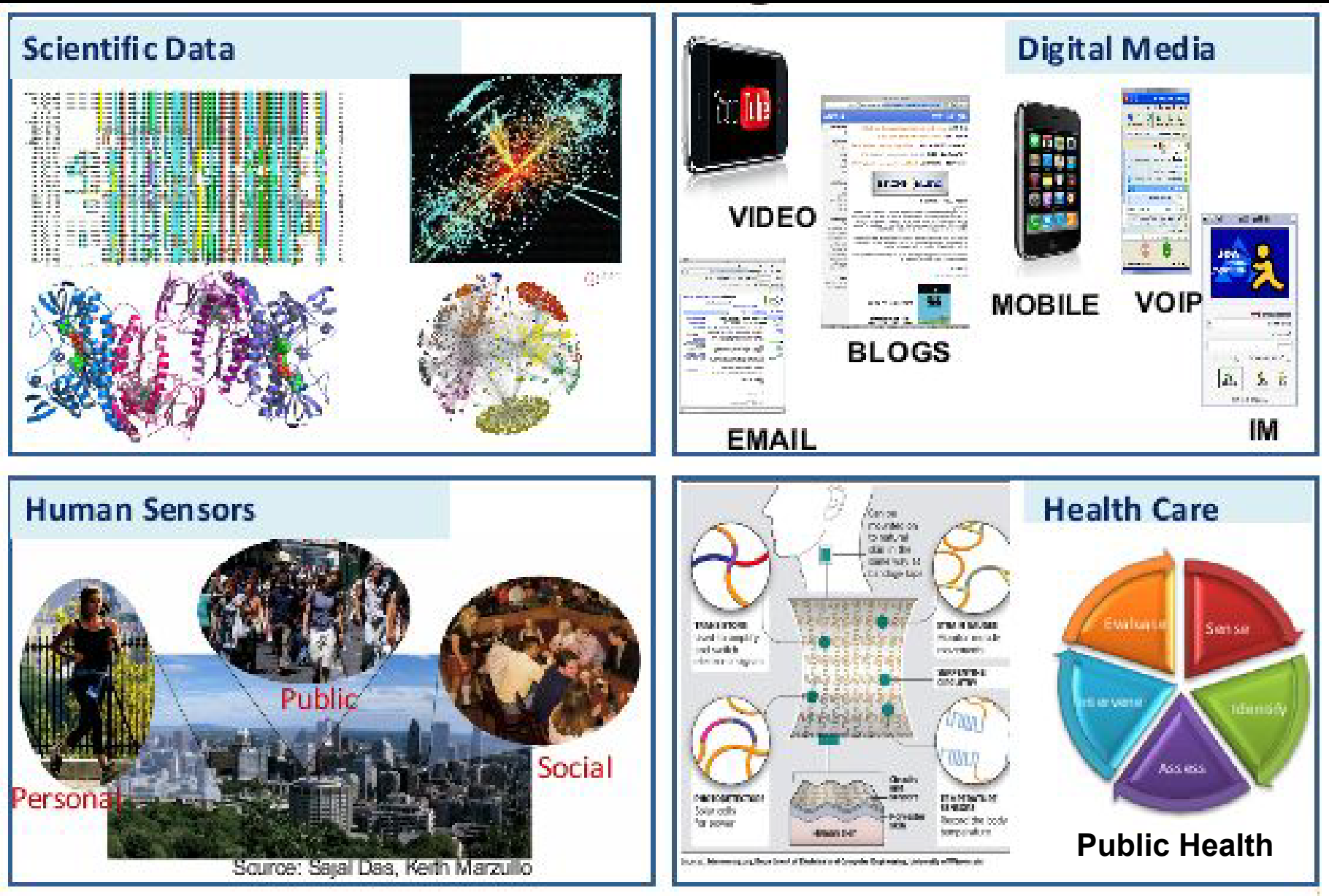
- Every patient should have access to the Internet.
- Every patient should have a device capable of digital communication and interaction.
  - Smart phone
  - iPad
  - Computer
- Patient should have access to all their health data.

Community

- The community engages in the health system.
- The community must accept equal responsibility for the patient with the health system.
- This responsibility means issues of transportation, access to health food, access to social events, access to parks for exercise, and provide person safety and health and education.

The clinical environment

Today everything is a source of data



REQUIRES

- Data Liquidity
- Data Sharing
- Data Standards

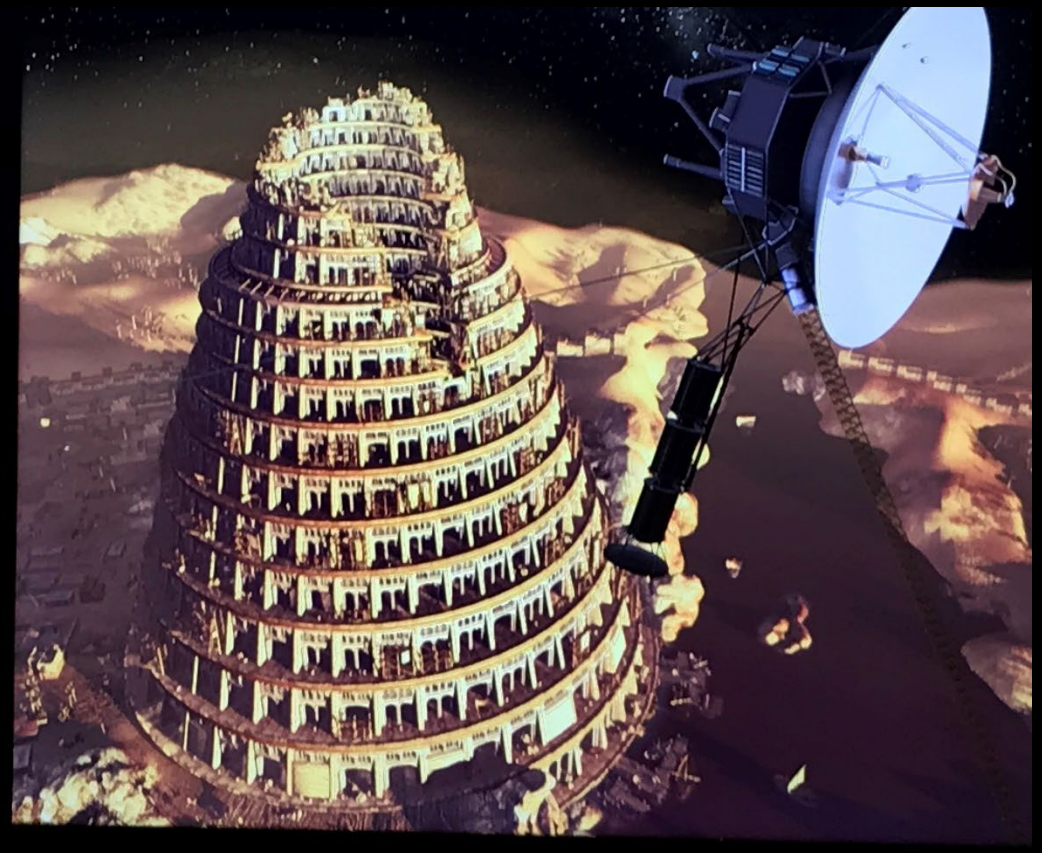
But the LORD came down to see the city and the tower the people were building. The LORD said, “If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them. Come, let us go down and confuse their language so they will not understand each other.”

Genesis 11:5-7

Pieter Brueget the Elder

The Tower of Babel

And the health professionals said “Let everybody choose their own data elements and terminologies, and we can map it all together.” And the result was interoperability-breaking chaos.



The Tower of Interoperability

Whose standards?

The Human Metric Project

- If we knew everything about a person, could we do a more optimal job of guiding an individual to a high quality and a longest possible length of life? That is the basis of the human metric project.
- But this project is more than that. It identifies the types of data we must collect – clinical, behavioral, social determinants of health, economic, geospatial, genomic, and environment.
- It addresses first issues of common and consistent data elements, including ta common language. It addresses how data is collected. It addresses how data is used. It addresses various packaging of data.

The Basic Requirements

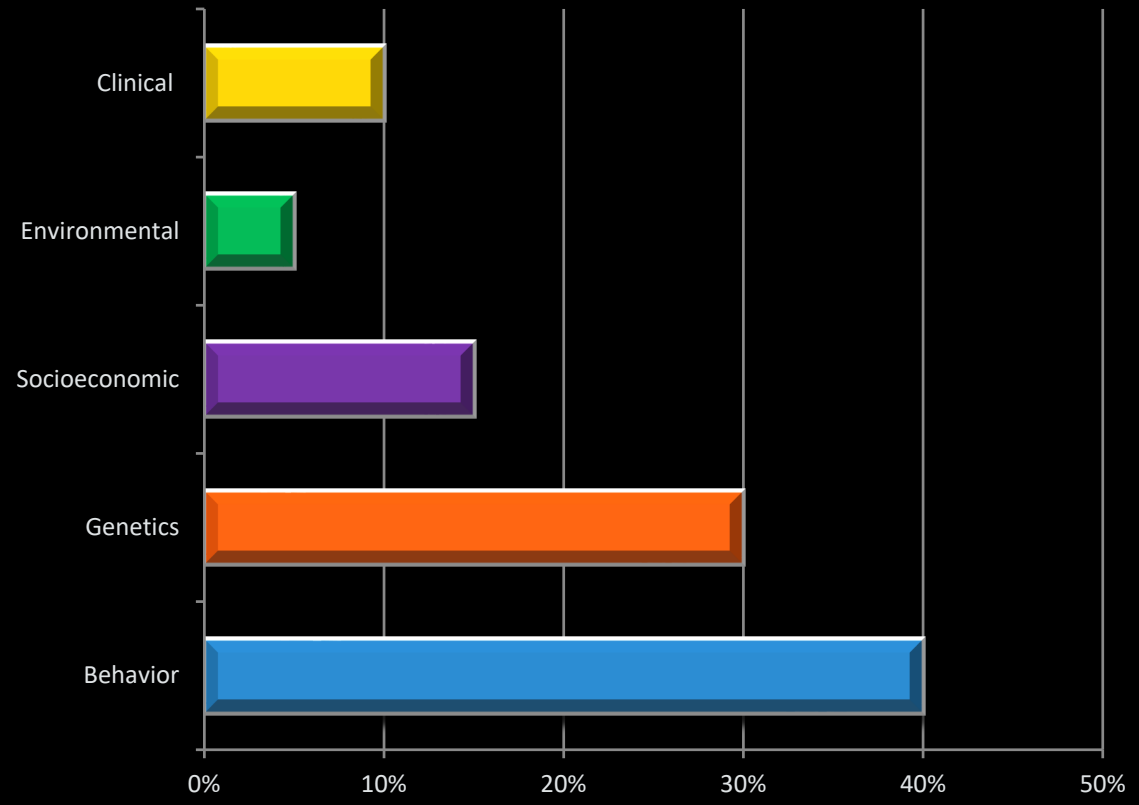
- Data Element – atomic level terms with rich attributes
- Data models – building complex structures from data elements such as blood pressure, heart murmurs
- Data sets – grouping of data elements for specific purposes
  - Phenotypes
  - Risk models
  - Knowledge models
  - Registries
  - Care plans

What is a perfect health system for clinicians?

- Access to any and all data about a patient.
- Longitudinal presentation of patient data, aggregated across all sources
- High quality and trustable data available when and where needed.
- Presentation of data as the clinician wants to see it.
- We all speak the same language – a seamless world of data.
- New forms of data capture – much data capture is automated.
- Use of AI to reduce finding the right data among Big Data.

New kinds of data

Social Determinants of Health

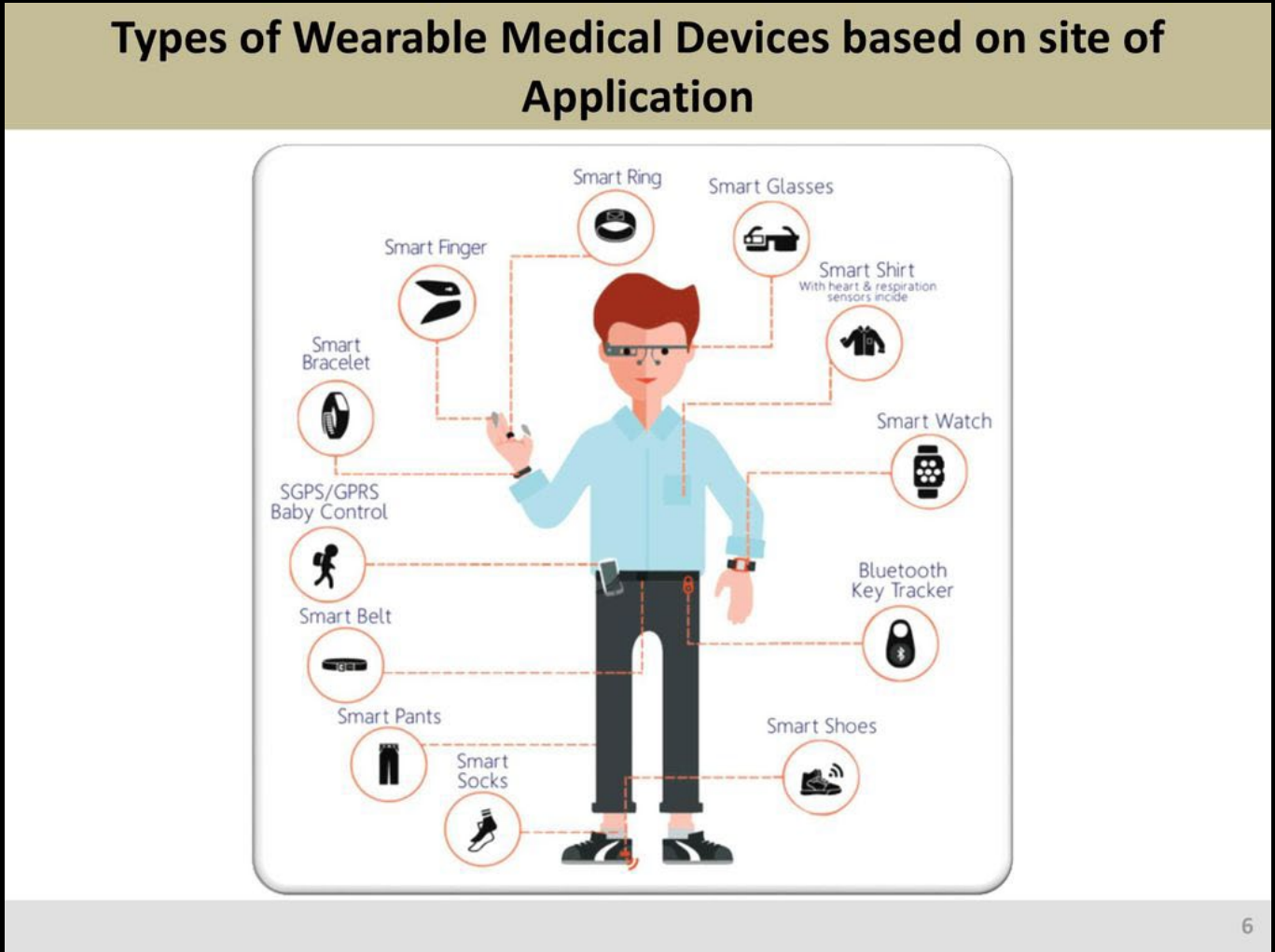


Mobile Devices

- The ubiquity of smart phones has changed communications between and among groups. A virtual visit will replace an office visit.
- Wearable sensors will give real time data about the person resulting in early interventions.
- Smart phone apps can be used for data collection by text, check boxes, and photographs with sufficient resolution to make clinical diagnoses in many areas such as dermatology.
- Smart phones can be used for education, behavior modification, and more.

Brick and mortar institutions will be replaced by virtual healthcare systems.

Wearable Sensors



- Real time data, all the time
- Sense instant change in condition
- Earlier intervention
- Appropriate intervention

Data Sharing becomes the norm

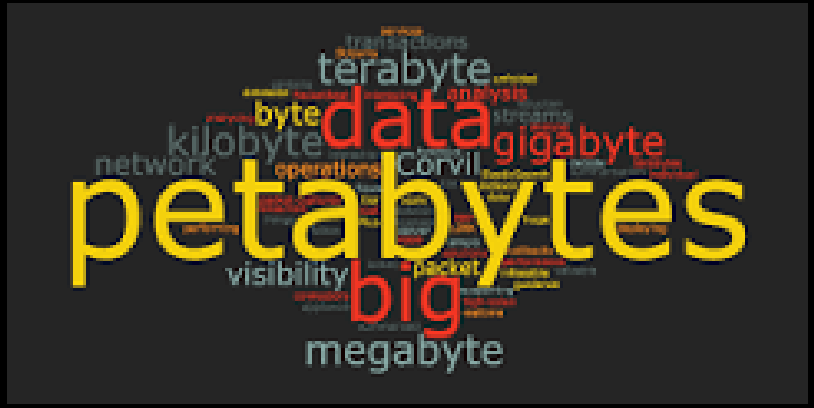
- Organizations unable to share patient data will find it very difficult to improve quality and avoid financial penalties under value-based care.
- Unique and universal patient identity becomes mandatory for error-free aggregation of data.
- Success depends on interoperability and that requires standards.

The New EHR

- Supports multiple use of data rather than secondary use.
- All data related to the patient is stored in a single virtual container labeled data box.
- Data box performs REST services – Create, read, update, delete
- Data storage is independent of data use.
- Use functionality is performed independently by functional apps.
  - Permits keeping up with new technology and new requirements
  - Allows specialization of data presentation and use
  - Enables competitive market
- Supports query based interactions: pull over push

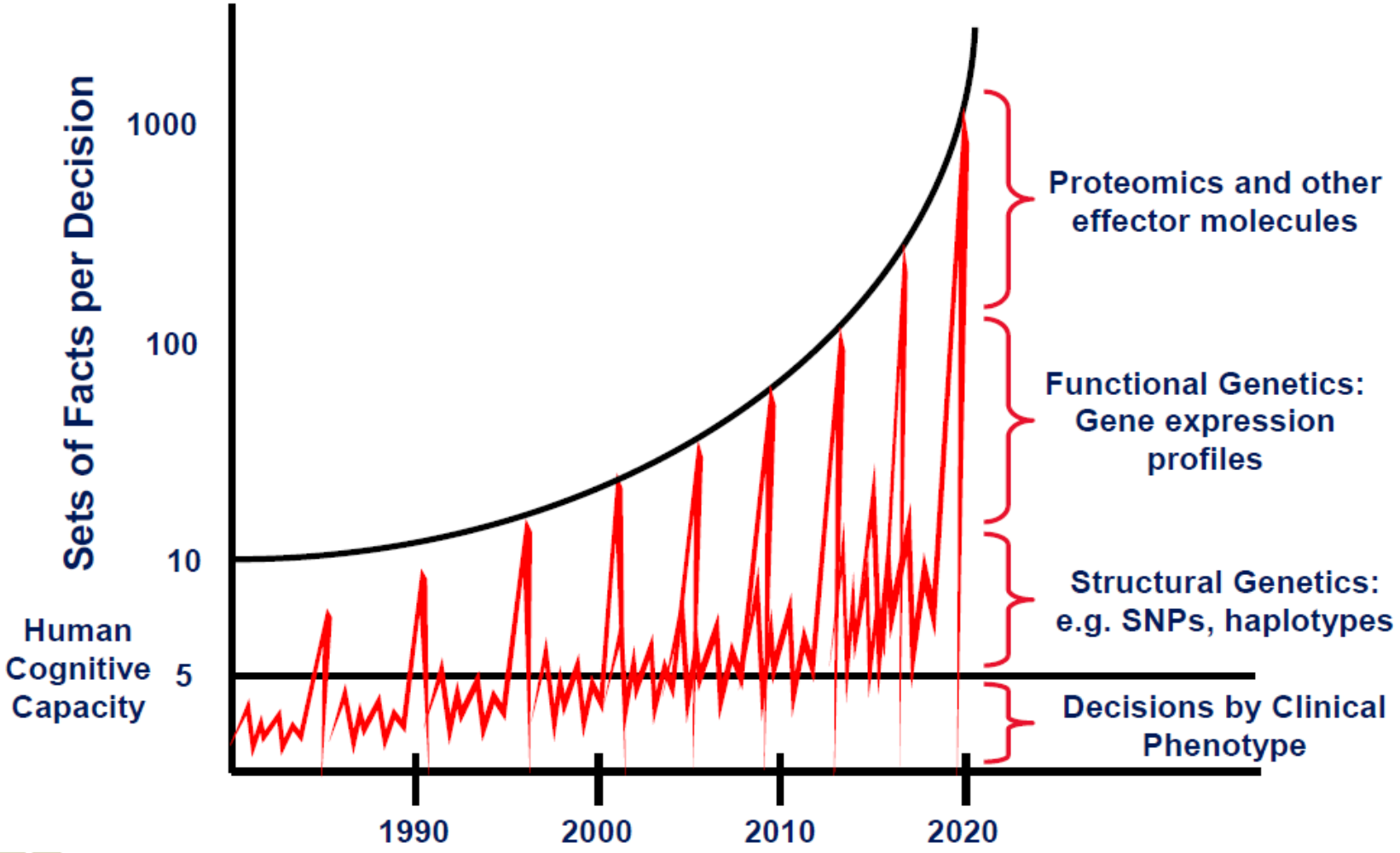
Big Data and Its Impact

- Big Data is a consequence of more things that create data and more initiatives to merge data.
- For a single patient, we are talking about petabytes of data; for a aggregated database of multiple patients, we are talking about exabytes or more.
- Computable knowledge is an award of Big Data.
- Requires new and innovative methods of analyses to create new knowledge
- NoSQL databases making their appearances to provide higher speed necessary for analyses.
  - Hadoop, mongoDB, others



In 2017, we created 44 zettabytes of new data daily.

Burning Platform: Overwhelming Complexity

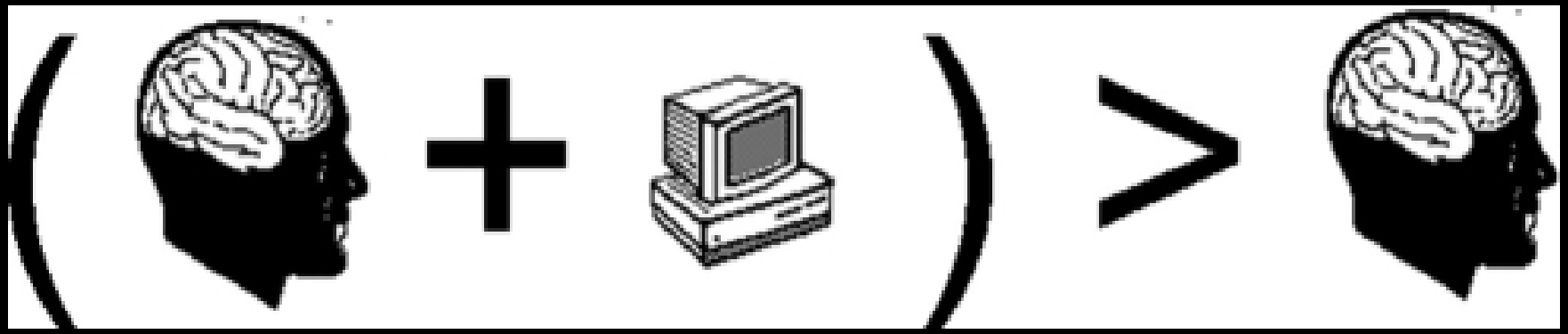


Stead WW. Beyond expert-based practice. IOM (Institute of Medicine). Evidence-based medicine and the changing nature of health care: 2007 IOM annual meeting summary,(Introduction and Overview, p. 19). Washington, DC: The National Academies Press 2008.

Decision Making

- The amount of data and the kinds of data influencing health and health care has far exceeded the ability of the human brain to make fact based decisions.
- Therefore, most health care decisions will be made by computers and executed directly without human engagement.

Fundamental Theorem

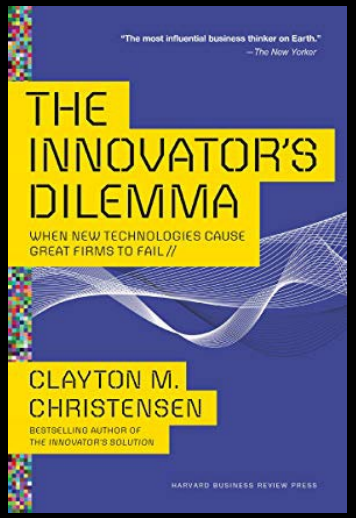


Source: Charles Friedman, UM

Perfect requires

- Universal Person Identifier
- Unique and atomic data elements creating a common data model
- Consistency in how data collected, how represented
- Increased data quality and trust
- Quality checked with data entry
- Document identification
- Common templates
- Common transport

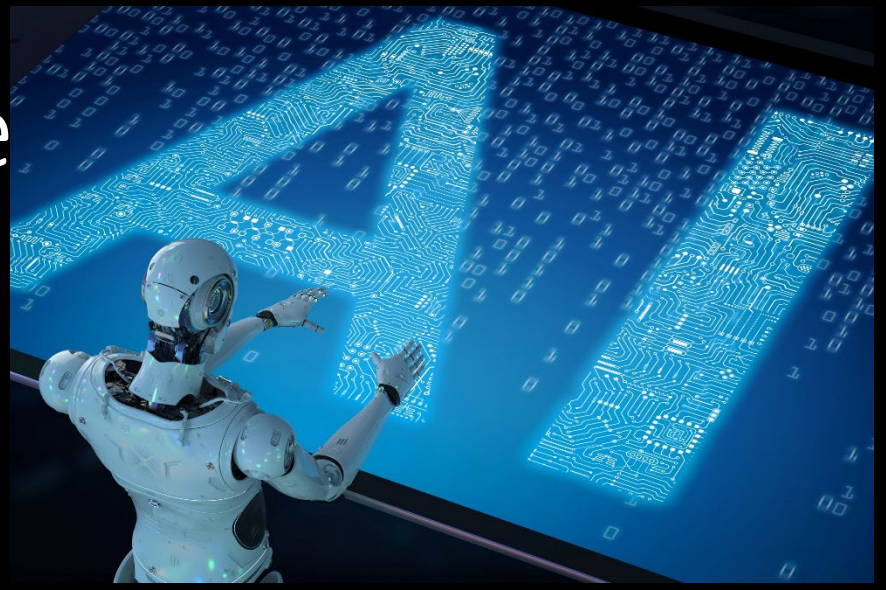
Disruptive Innovation Makes Perfect

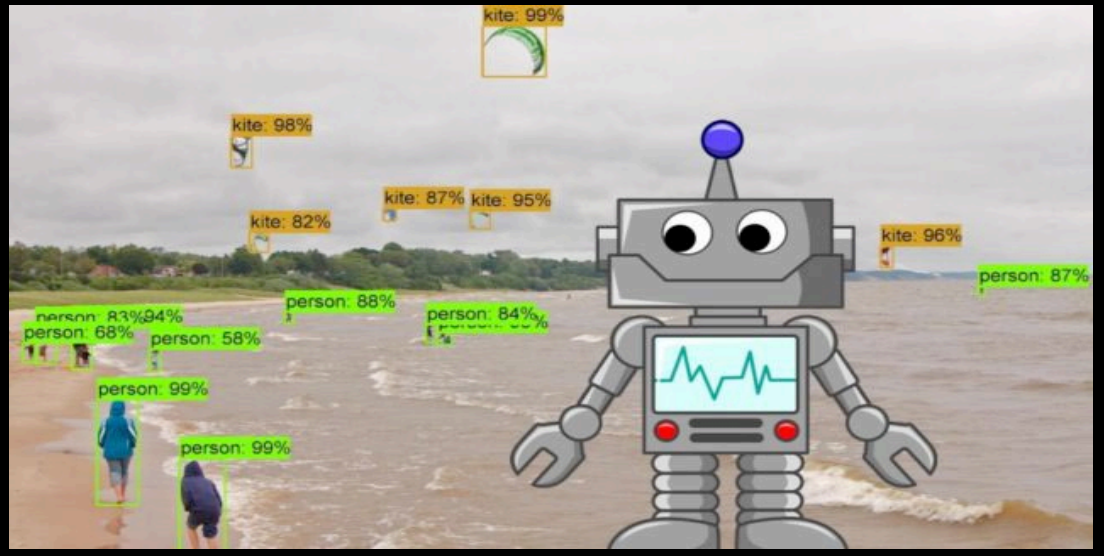


- Integration of images and enhanced use
- Biomarkers and genomics
- Enhanced registries – automated population of registries
- Automated Clinical Trials, Observational Clinical Trials, Pragmatic Clinical Trials
- Partnered iAPPs to tell a complete story
- Perfect provides the right data for the right patient to the right clinician at the right time for the right reason.

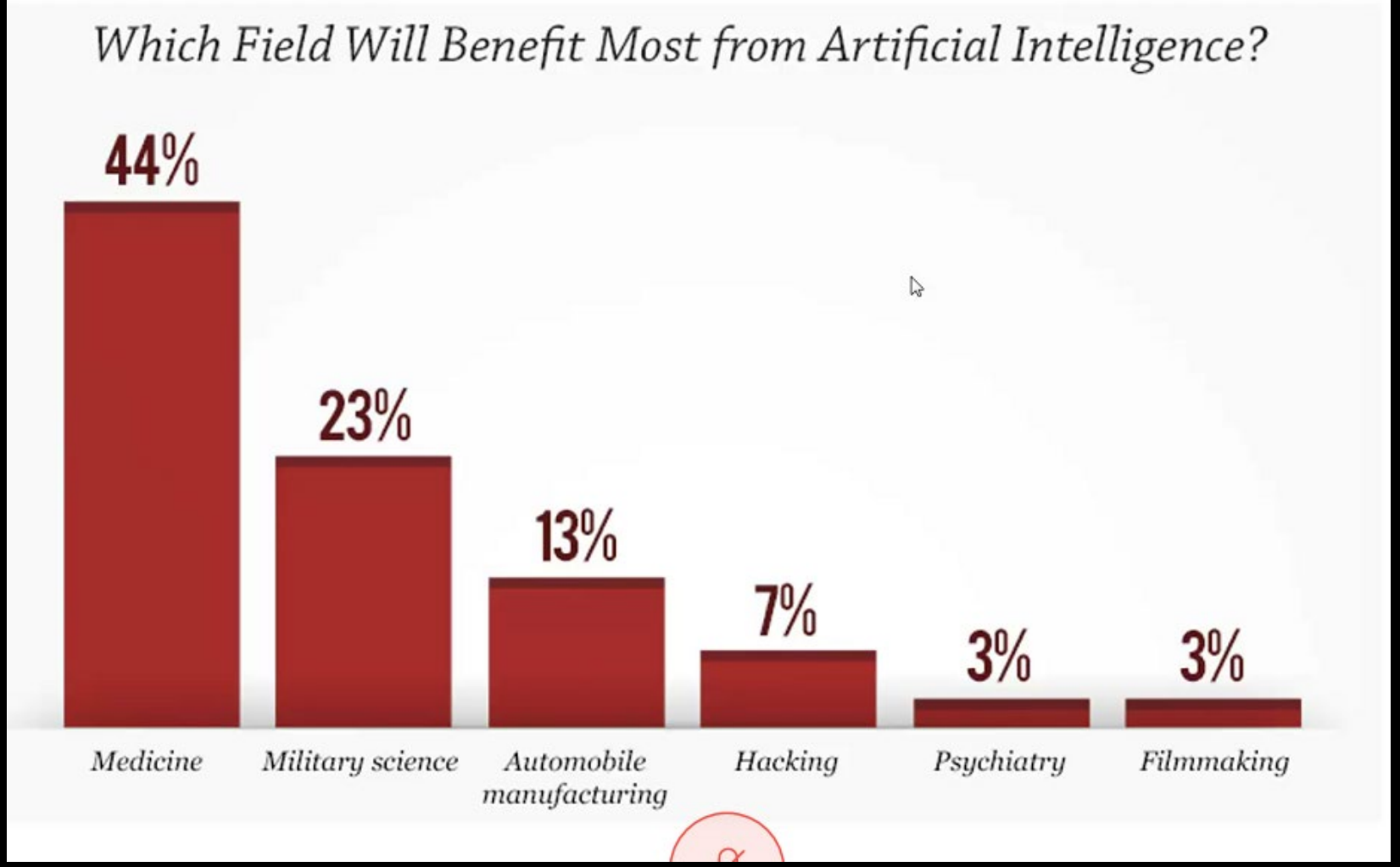
The Second Machine Age

- Cognitive Computing
- Machine Learning
- Deep Learning
- Artificial Intelligence





2016 CBS/Vanity Fair Poll of Random Sample of 1021 Adults



The Power of AI

- We can teach computers to do specific things. We are a long way from Artificial General Intelligence.
- Computers learn from environment. Needs sensors to read environment.
- What we can gain through AI is specific narrow tasks which includes decision making, surgery, or like tasks.
- Challenge is the John Henry syndrome.

Definitions

DATA SCIENCE

- In computer science, artificial intelligence, sometimes called machine intelligence, is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans
- Machine learning is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead.
- Deep learning is part of a broader family of machine learning methods based on artificial neural networks with representation learning. Learning can be supervised, semi-supervised or unsupervised.

Source: Wikipedia

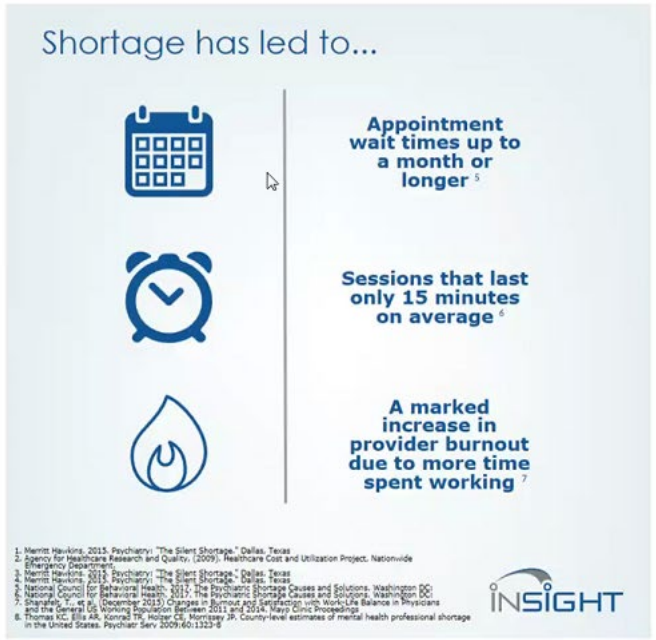
Narrow AI vs General AI

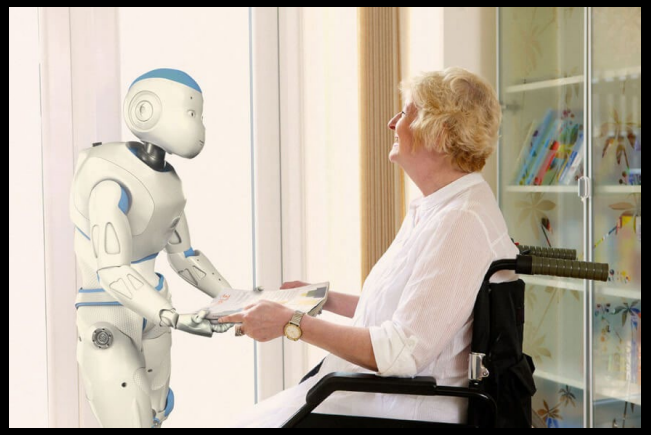
- Narrow Artificial Intelligence
  - Classic model
  - Expert system
  - Machine Learning

- General Artificial Learning

Consciousness Central 2018 - Program 5 with Sophia the Robot, David Hanson, Julia Mossbridge

Psychiatry shortage escalates as mental health needs grow



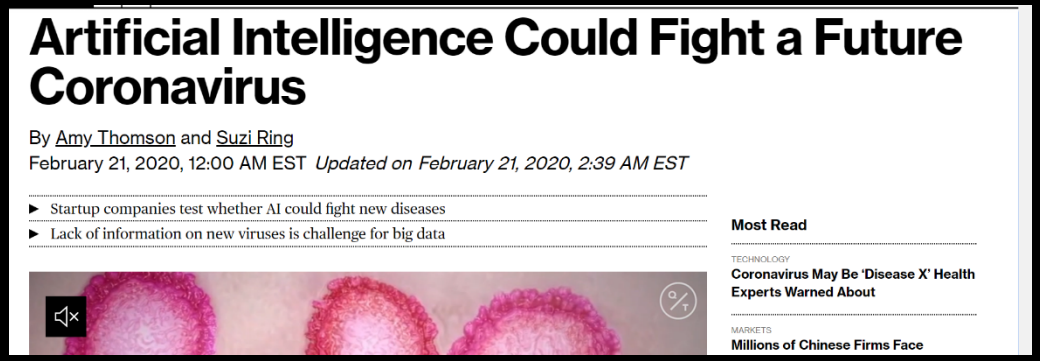


What's happening today

CMS announced a $1 million prize for (AI Health Outcomes Challenge) for best demonstration of how AI can be used to predict unplanned admissions and other untoward events.

The AMA voted to promote augmented intelligence education (AI) for physicians and house staff.

Ginni Rometty, former CEO of IBM predicted that by 2021 "Cognitive AI will impact every decision made."



So, what can we expect?

- "Soon, it will be hard to imagine a doctor's visit, or a hospital stay that doesn't incorporate AI in numerous ways. With healthy clinical evidence, we'll see AI become more mainstream in various clinical settings, creating a positive feedback loop of more evidence-based research and use in the field. In addition, AI and ambient sensing technology will help re-humanize medicine by allowing doctors to focus less on paperwork and administrative functions, and more on patient care.

Pete Durlach, senior vice president for healthcare strategy and new business development at Nuance.

More perspectives

- “Healthcare AI technology is currently in the testing phase and organizations will continue to push into the broad adoption phase,” he said. “The possibilities are endless; the key is that when done successfully, it won’t even feel like AI. AI will simply be another tool in our toolbox to help payers and providers.”
- AI-powered practice management assistance: patient acquisition, efficient intake and scheduling, and efficient billing. AI will be able to identify patterns between a practice management activity and the end action and predict behavior moving forward.
- “The simplest pattern could be multiple missed appointments, but that is not a challenge to detect with classical systems,” he said. “AI can combine all of the data inclusive of missed appointments, lead time for scheduling an appointment, time-to-respond to an appointment confirmation, even time of the year, perhaps. Disengagement is seasonal or based on the time of day. The power of AI is the ability to take an ever-increasing set of variables and produce a predictive model with more powerful predictive power than what could be explicitly coded.”

Tim Costantino, AdvancedMD

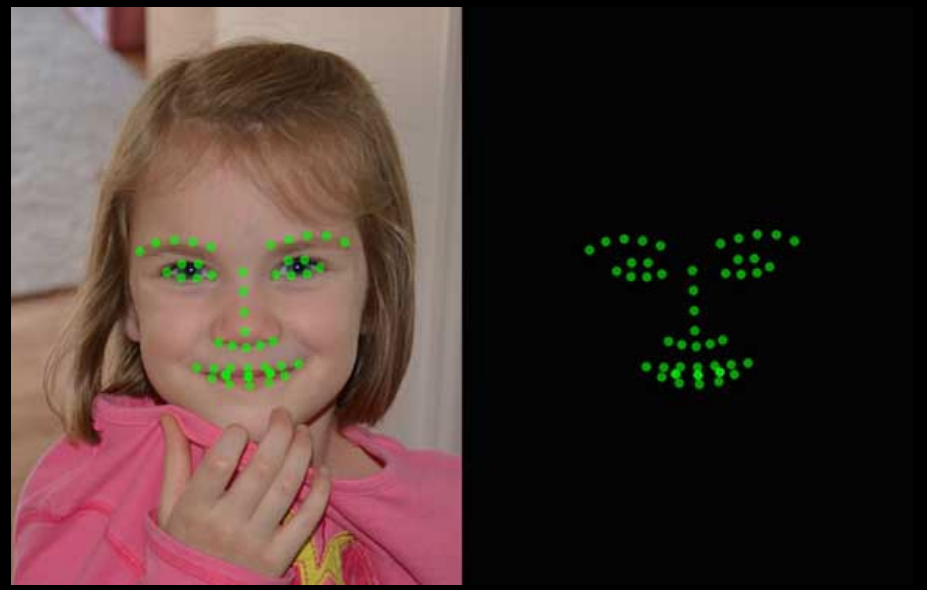
Clinical AI applications present a range of computational difficulty

- Image processing tasks - recognizing the border of an organ to suggest where to cut off a scan, or highlighting a suspicious area in an image for the radiologist or pathologists are relatively easy because the analytic task is narrowly defined.
- Image analysis and diagnostic prediction such as screening fundoscopic images for diabetic retinopathy are harder, but feasible with today's technology.
- Very broad data analysis and pattern recognition tasks such as analyzing heterogeneous data sets to suggest novel associations are infeasible today because the purpose is limited to hypothesis generation.
- Thinking in the way humans do – reasoning from a few observations to suggest a novel scientific framework as Einstein did with the theory of relativity – is beyond technology on the horizon.

Stead – JAMIA editorial 2018

Some projects at Duke

- Autism
- Patterns in electronic health records
- Management of opioids
- Medication management
- Ophthalmology
- Radiology
- Exercise physiology
- FORGE
- Duke Institute for Health Innovation

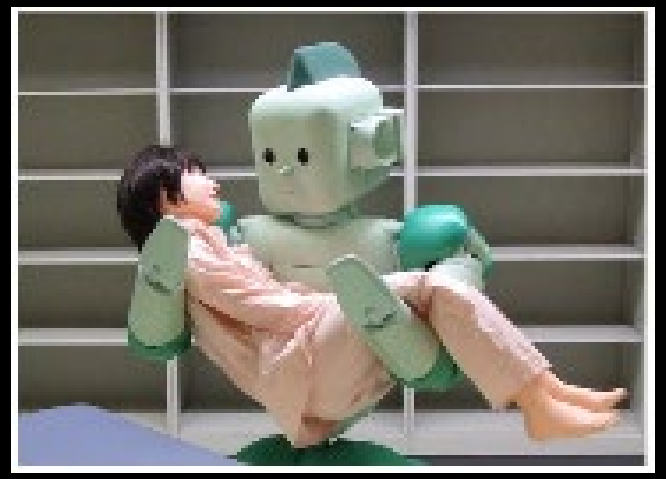


AI Models

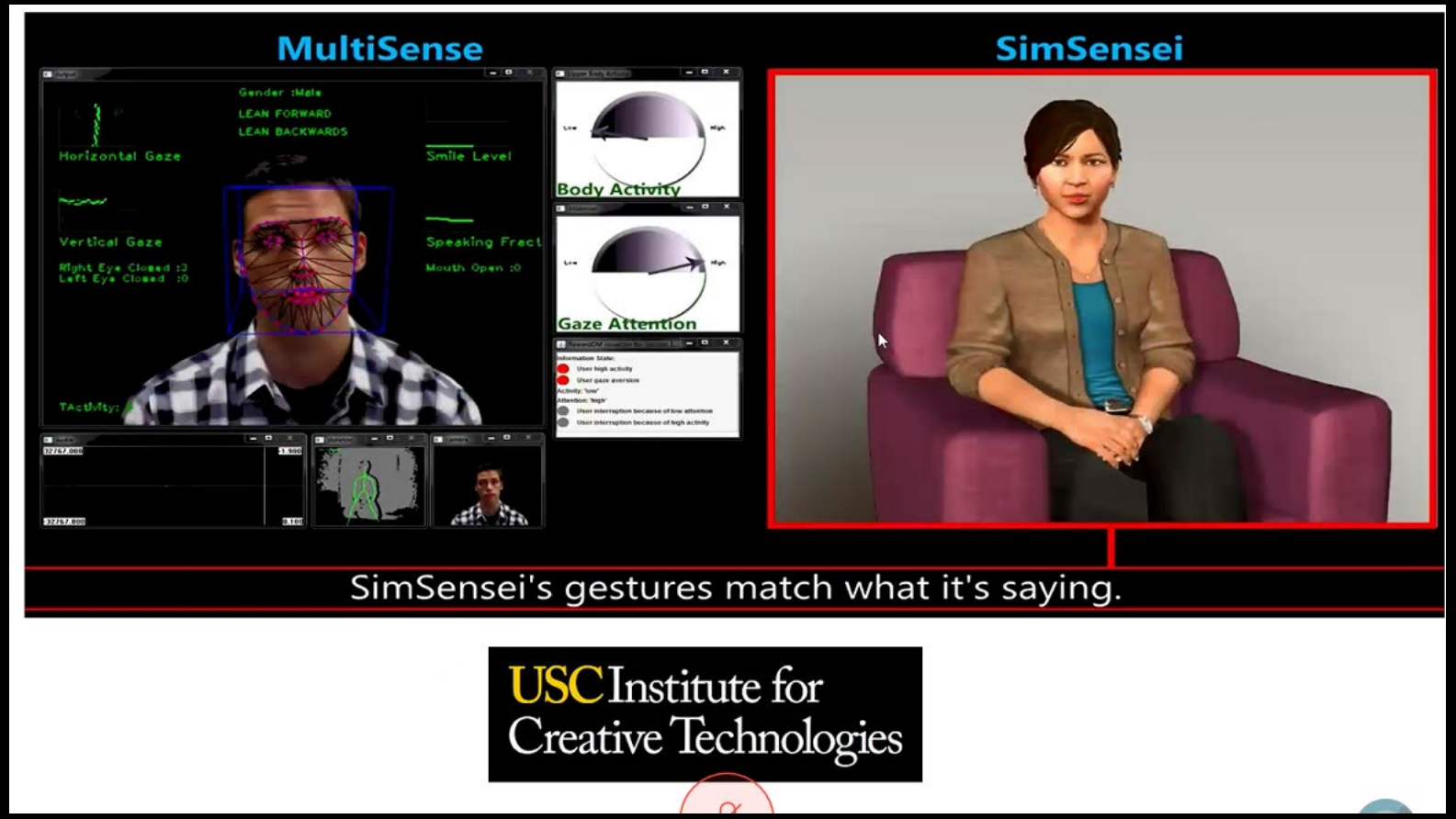
- AI models are being built in healthcare management and risk assessment
  - Understanding capacity for volume of patient visits in offices
  - Predicting patients who are at highest risk of re-hospitalization
  - Understanding different levels of risk in patients with chronic disease
  - Identify patients of high risk of progression of kidney disease
  - High risk of complications of diabetes
  - High risk of having complications after surgeries

Source: Dr. Marroquin, UPMC

Robots and Avatars



Virtual, Mixed and Augmented Reality



Perfect and the future

- Society should demand the perfect system.
- Can we make the changes necessary to enable the perfect system?
- How much will the transition cost?
- Should it be global?
- Who will be the leaders?