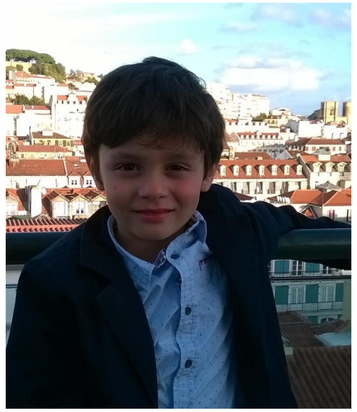
# 8TH CHALLENGES in CARDIOLOGY

**JULY 2018**

## DIGITAL HEALTH: MANAGING PATIENTS AND DISEASE

# Boa tarde



CATÓLICA LISBON
BUSINESS & ECONOMICS

Prémios MARKETEER


"WE THRIVE WHEN WE ARE PULLED BY THE FUTURE

NOT PUSHED BY THE PAST."

# Cyber-Bio-Physical

# 2007

iPhone (January 9th, 2007)

VMWare: translation software

Hadoop: storage capacity

GitHub: Open-source writing & collaborating

FB: open to anyone >13 yrs. Old

Twitter

Change.org

Google buys YouTube (2006) and launches Android

Bitcoin: “Satoshi Nakamoto”

Amazon releases Kindle

Airbnb

1B internet users

Watson (IBM)

Intel: Non-silicon materials

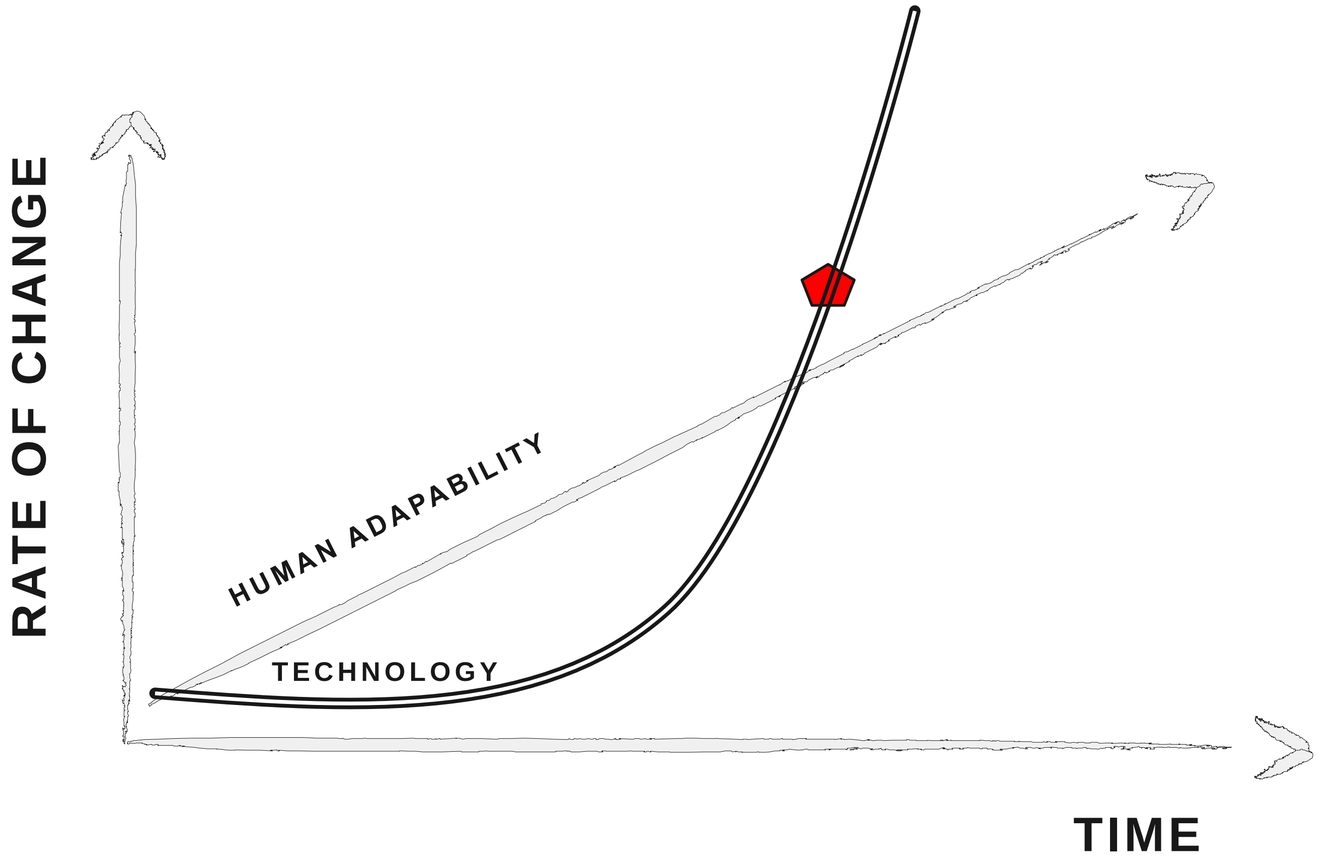
寧為太平犬，不做亂世人

pinyin: níng wéi tàipíng quǎn, bù zuò luànshì rén

*"It's better to be a dog in a peaceful time than be a man in a chaotic period"*

**Tipping Point**

# Introduction to Ubiquity




CULTURAL ANGST

15 YRS. TO ADAPT

**CONSTANT “CATCH UP” MODE**

**CHANGES:**

TECHNOLOGICAL

GEOPHYSICIAL

SOCIAL

**Eric Teller, CEO of Google X Research & Development Lab**

# Learning

**1950** Medical knowledge and data doubled every **50 years**

**1980** Medical knowledge and data doubled every **7 years**

**2010** Medical knowledge and data doubled every **3,5 years**

**2020** Medical knowledge and data doubled every **0,2 years** or 73 days.

Source: Elsevier

Transactions of the American Clinical and Climatological Association

**Primary care physician would need 630 hours/month to keep up with his/her practice.**

# Learnability

**“THE ABILITY TO ANSWER QUESTIONS WILL NOT DISTINGUISH SOMEONE’S INTELLIGENCE. THE ABILITY TO ASK ALL THE RIGHT QUESTIONS WILL BE THE MARK OF TRUE GENIUS.”**

JOHN KELLY

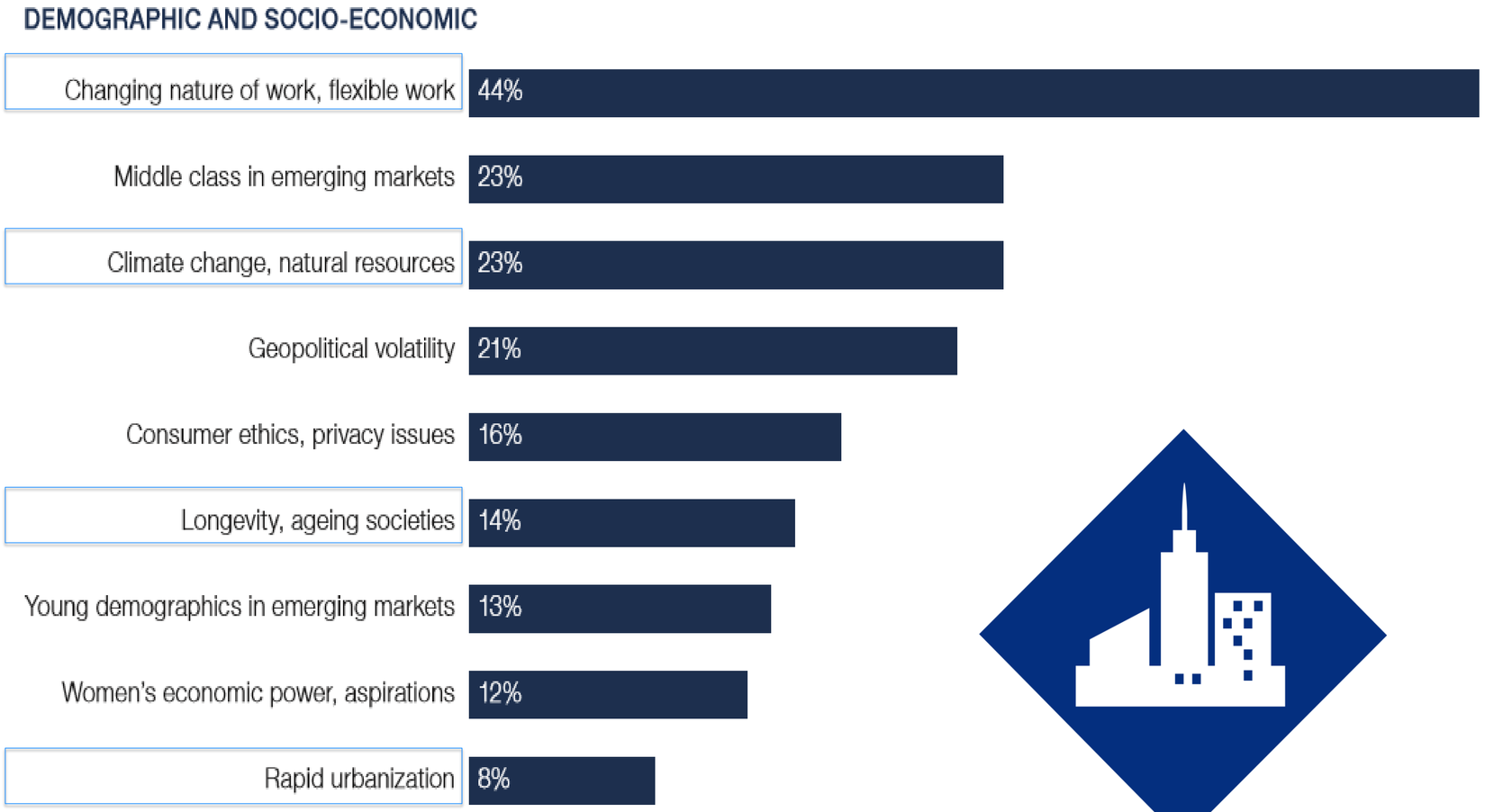
VP OF COGNITIVE SOLUTIONS AT IBM

KNOWLEDGE STOCKS: DEPRECIATE AT AN ACCELERATING RATE

KNOWLEDGE FLOWS: EXPAND AT AN ACCELERATING RATE

**Asking the right questions is the key to our development.**

# Impact on Industry






**Urbanization, ageing, resources and work**

# HONDAs

**INCREASED DEMAND**. 2020 (F) = $1,6T USD

**DEMOGRAPHY**

**INCREASED ACCESS TO HEALTHCARE**

**DISEASE TYPE**: NON-CONTAGIOUS DISEASES

44M DEATHS/YEAR IN 2020

(INCREASE OF 15% VIS A VIS 2010)

**70%** Of healthcare costs

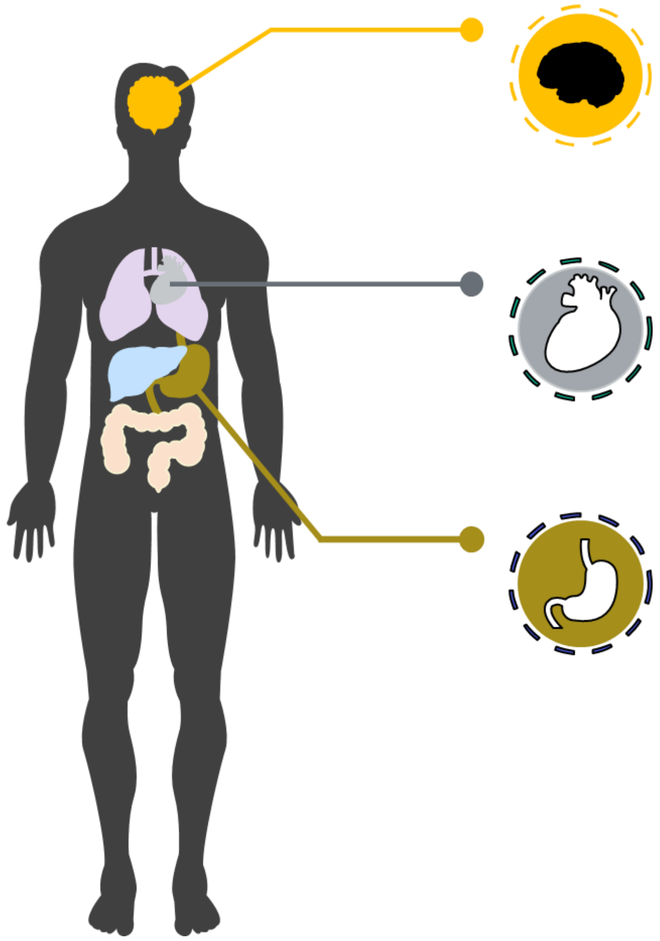
More people, More sick people, More long-term treatments, More access

More COSTS and Resources!!!

Source: WHO

**Hypertensive, Obese, Non-Compliant, Diabetic, Asthmatic**

# 3Ps of Healthcare

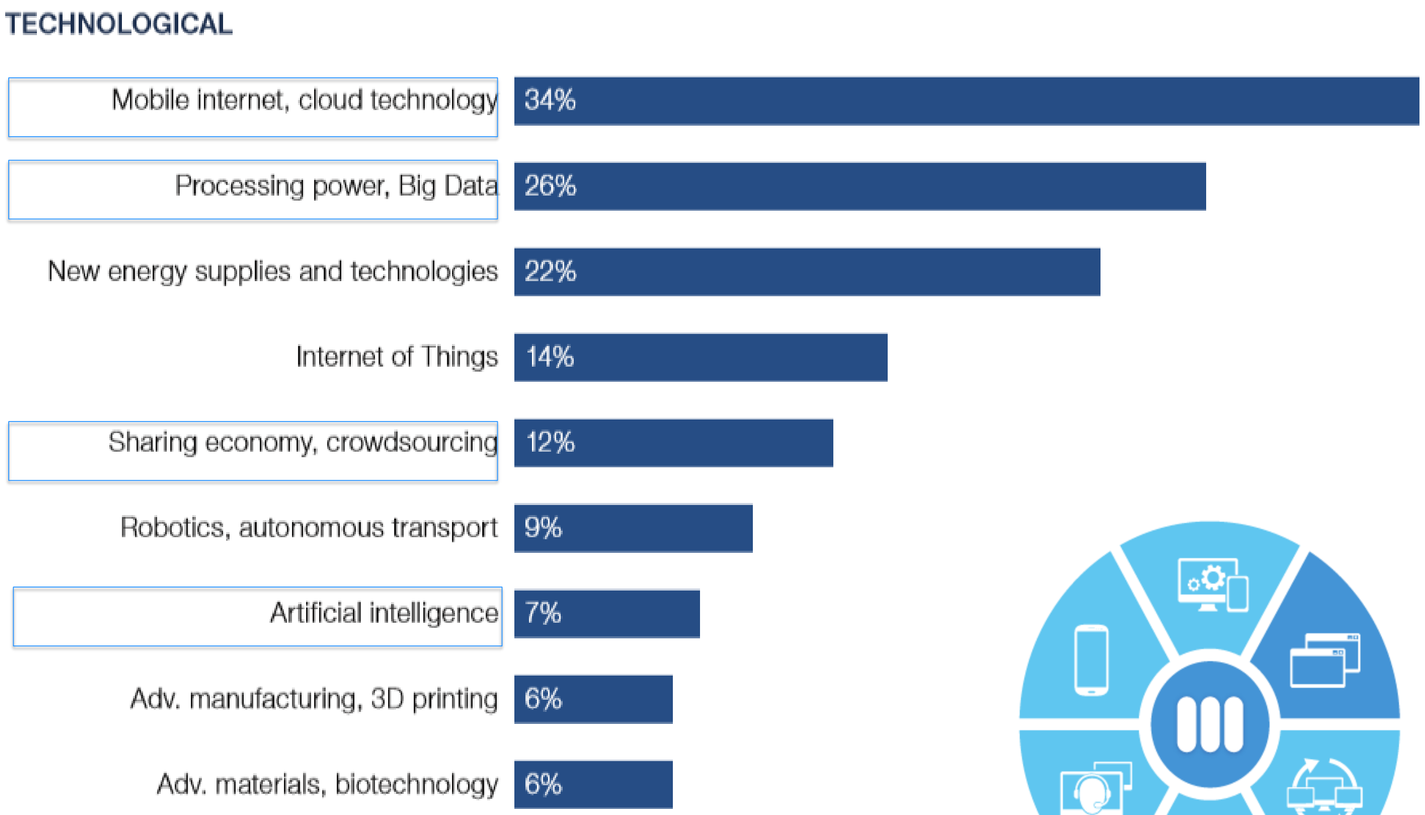


**Providers:**
↑ Demand for services
Strain on resources

**Patients**
↑ Control and Participation
Proactive health decisions

**Payers**
↑ Costs
Unsustainable System

# Impact on Industry

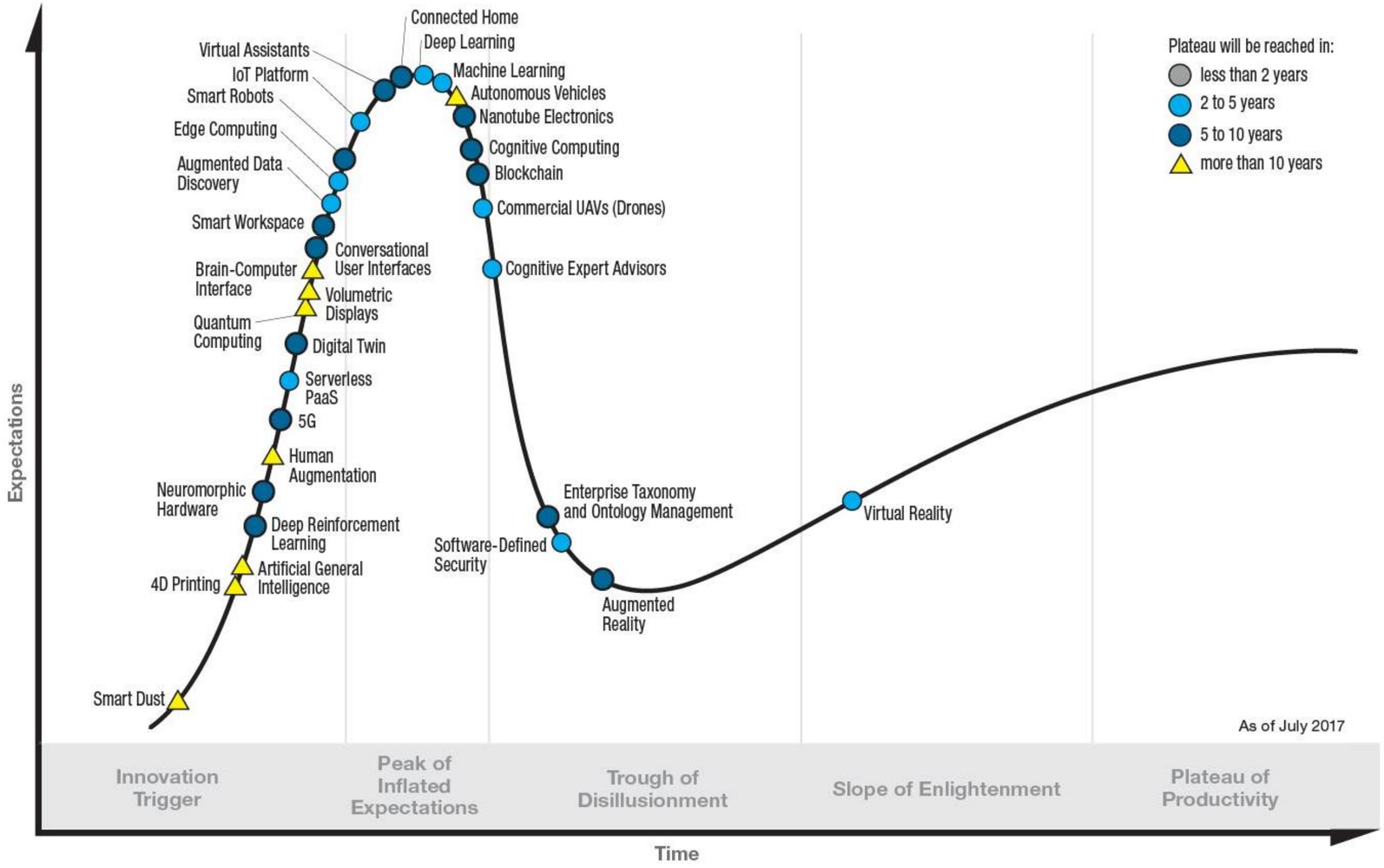



Source: Future of Jobs Survey, World Economic Forum.
Note: Names of drivers have been abbreviated to ensure legibility.



**Cloud, Processing, Data, AI, P2P**

# Time to Impact




**Gartner Hype Cycle**

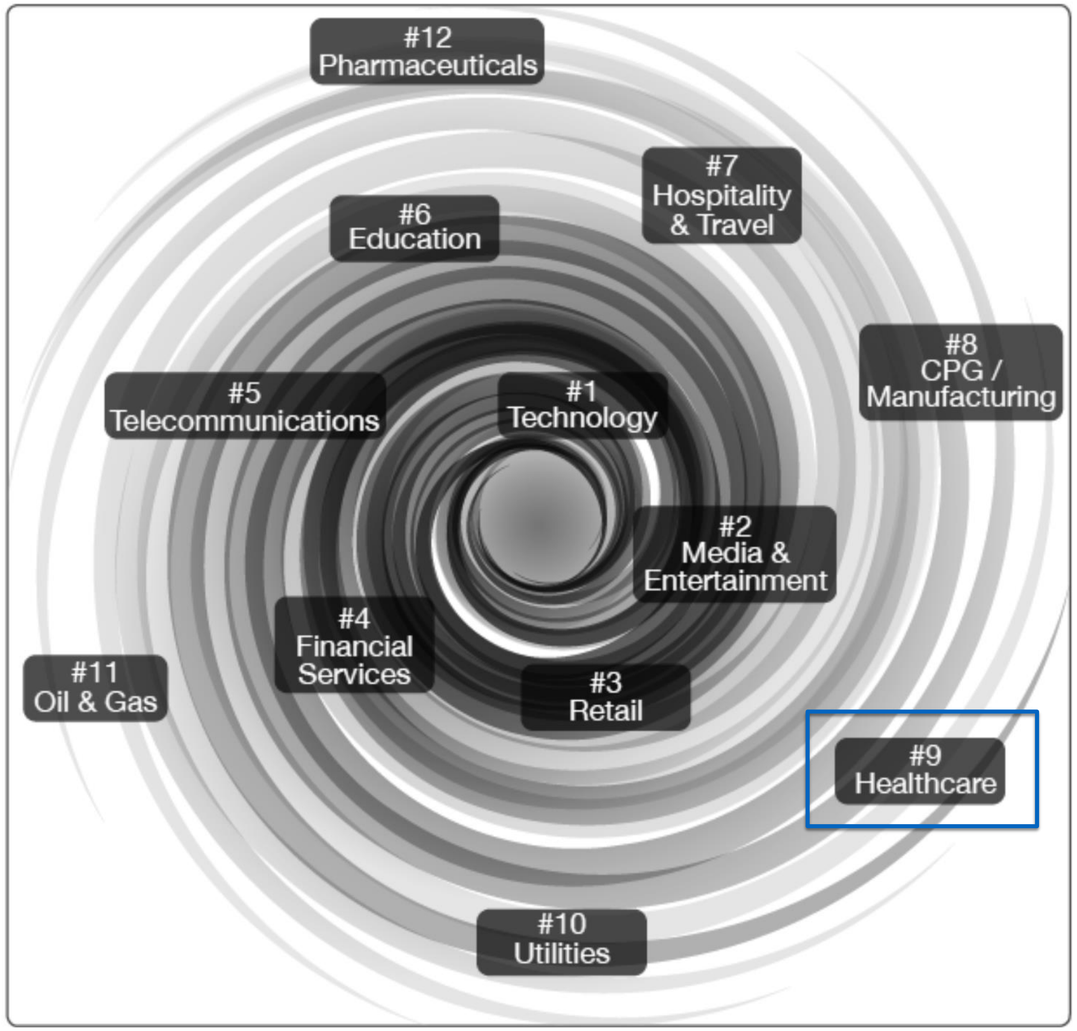
# Digital Vortex

Combination of surveys and objective data.

Plotted 12 industries on a digital vortex.

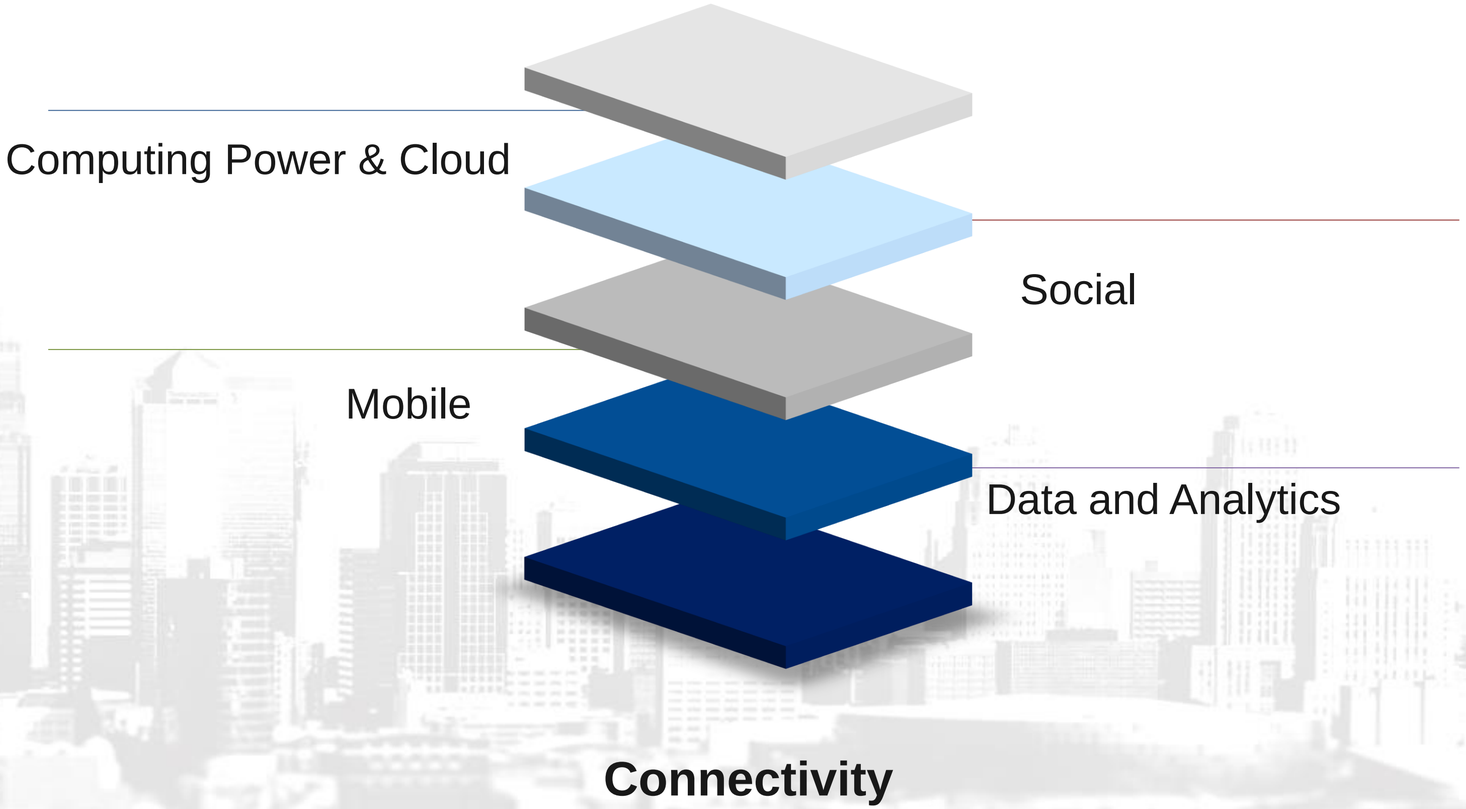
Industries on the outside are least affected by digital disruption.
Those closer to the middle are most heavily impacted.

Source: IMD + Cisco




**Velocity vs. Acceleration / Disruption vs. Displacement**

# Pillars for DT

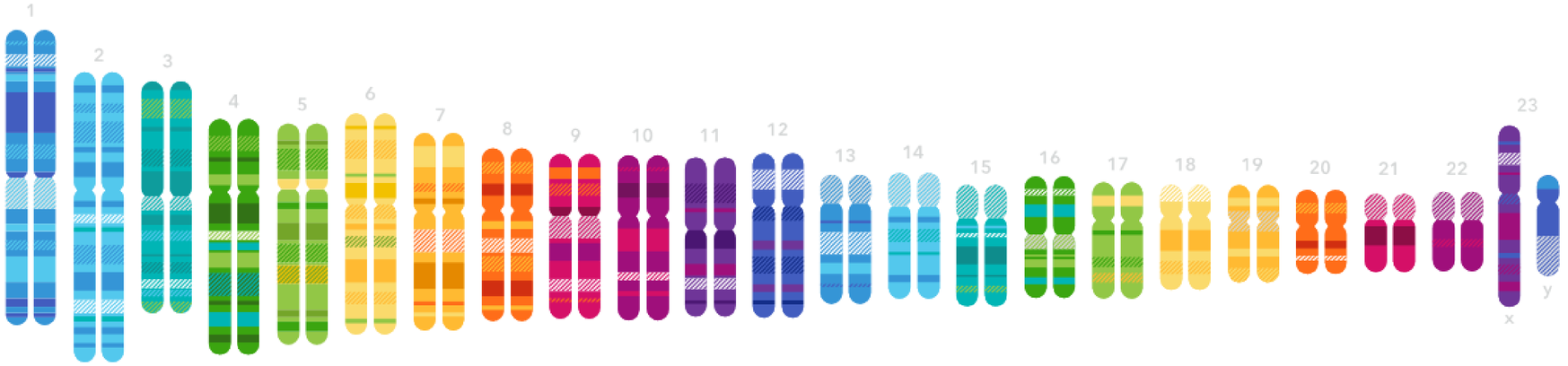



**Big Data Analytics + Consumer Health Data + Preliminary Evaluation = Actionable Insights**

# Stregthening Scientific Base

In effect, two changes are taking place concurrently.

- Our technologies for **collecting biological data** are improving by many orders of magnitude.
- Our technologies for **synthesizing and analyzing** that data are also becoming much cheaper and more efficient.




Source: From Vision to Decision Pharma 2020. PWC

**Data is the new oil and Moore's Law is the engine**

# Big Data and IoT

**2,5M Tetrabytes** Data created daily

**INDIVIDUAL LEVEL: WE CAN TRACE A DETAILED PORTRAIT OF A PATIENT'S HEALTH**

**AGGREGATE LEVEL: DEEP RESERVOIRS OF KNOWLEDGE ABOUT ENTIRE DISEASE STATES AND PATIENT POPULATIONS.**

Source: From Vision to Decision Pharma 2020. PWC

**Volume, Velocity & Variety**

# Strengthening Scientific Base

**Prognos** (former Medico):
AI company.
Registry of:
**5 Billion clinical records**
**100 M patients**,
**30 disease areas**.

The registry enables earlier identification of patients who can benefit from enhanced treatment decision-making, risk management, and quality improvement under the HEDIS guidelines.
**500 proprietary and learning clinical algorithms**.

**23andMe:** invite people who use its testing service to share information regarding medical history and lifestyle contributing to genetic research.

**AI and computational power**

# Big Data and IoT

“Anywhere interface” technologies

Provides JIT information on how patients respond to different treatments

**CardioDX:**

Specialized in cardiovascular genomics R&D company that analyzed over **100M samples** to identify **23 markers of coronary artery disease**

Fuse genomics, biostatics, cardiology and primary care

**BIOLOGICAL DATA + ANALYTICAL TOOLS = PERSONALIZED MEDICINE**

**Corus CAD test: integrates age, sex and gene expression to calculate a score**

# Data as a tool for Compliance


It is believed that up to **50% of patients with chronic diseases** are **noncompliant with medications.**

In 2014, it was estimated that medical noncompliance adds between **$100-$300 billion annually in healthcare costs**.

**Proteus Digital Health** have created the world's first smart pill with an ingestible sensor linked to a wearable patch that can record when a pill is actually taken.

ABILIFY MYCITE is a drug-device combination product comprised of oral aripiprazole tablets embedded with an Ingestible Event Marker (IEM) sensor. **FDA First Approval: Nov. 13, 2017**

**The most important V in data is Value.**

# Healthcare and Machine Learning


https://www.nature.com/articles/nature21056

Machine learning has enormous potential to disrupt healthcare.

**Diabetic retinopathy** is one of the leading causes of blindness that can be treated if caught early. One early exemplar of AI in healthcare is the work that Google (TensorFlow) research team did to **classify retinal images** to help expand access and improve quality of care with machine learning solution.

**Dermatologist-level classification of skin cancer** with **deep neural networks**. using a dataset of **129,450 clinical images**. Tested its performance against **21 board-certified dermatologists** on biopsy-proven clinical images.

2 critical binary classification use cases:

i) keratinocyte carcinomas versus benign seborrheic keratosis

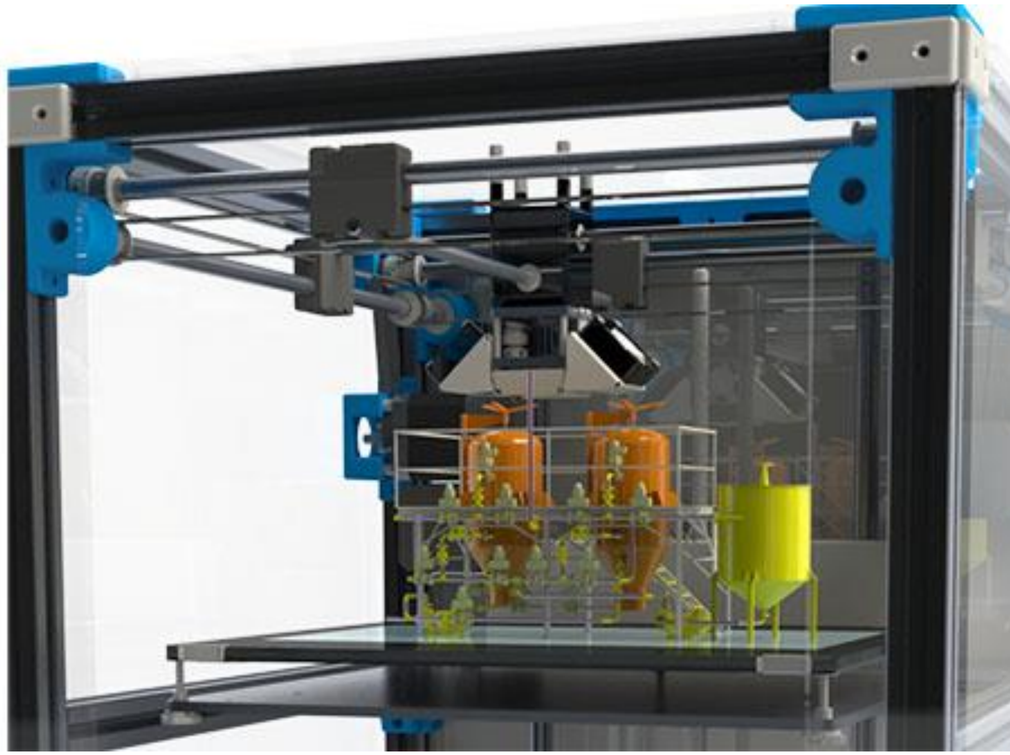
ii) malignant melanomas versus benign nevi.

# 3D Printing

Chemist **Lee Cronin** is working on a 3D printer that, instead of objects, is able to print molecules. An exciting potential long-term application: printing your own medicine using chemical inks.

Cronin has been awarded a 2018 RSC interdisciplinary prize, in recognition of his ground-breaking work exploring complex chemical systems and digitizing chemistry using artificial intelligence.

A new method of drug manufacture which uses 3D printers to create pharmaceuticals on demand could lead to a **‘Spotify for chemistry’.**



Production of muscle relaxer Baclofen

https://www.ted.com/talks/lee_cronin_print_your_own_medicine

**“Chemputer”: Produce when and where it is needed**

# Mobile Health

**33%** Of US patients use Health Apps in 2016 (vs. 16% in 2014)

**21%** Use wearables for health purposes.

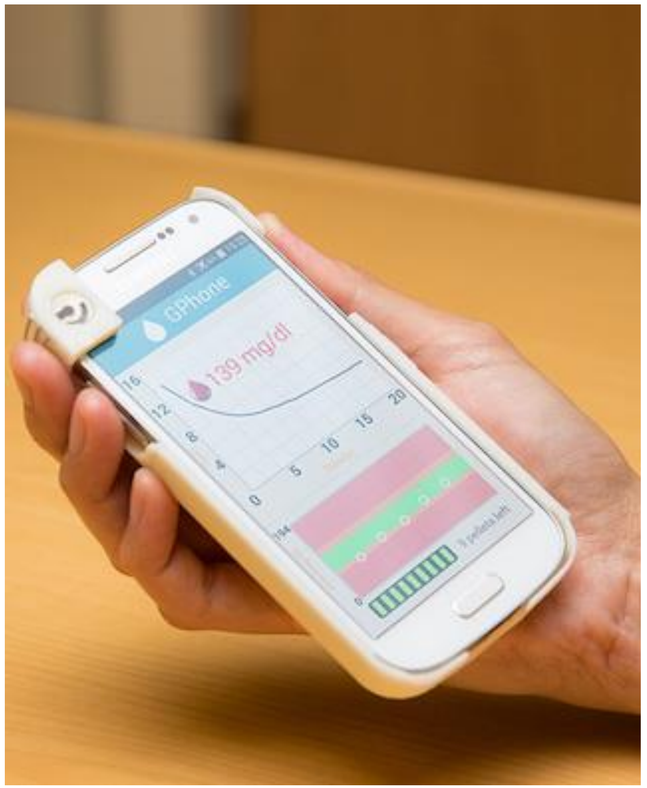
**50%** Of US Millennials agree with the statement “I want my doctor to use my fitness tracker and/or health app data.”

Sources. 2015 Across Health Navigator ; IMS 2016

Apps and Wearables.

# Mobile Ubiquity

Reusable glucose-monitoring smartphone case developed by UC San Diego engineers




A new **reusable glucose-monitoring smartphone case** developed by engineers at the University of California San Diego.

The added benefit is the ability to autonomously store, process, and send blood glucose readings from the phone to a care provider or cloud service.

The device, called **GPhone**, is built into a smartphone case with an accompanying app which lets patients record and track their glucose readings. The 3D-printed case fits over the smartphone and has **a permanent, reusable sensor on the corner**.

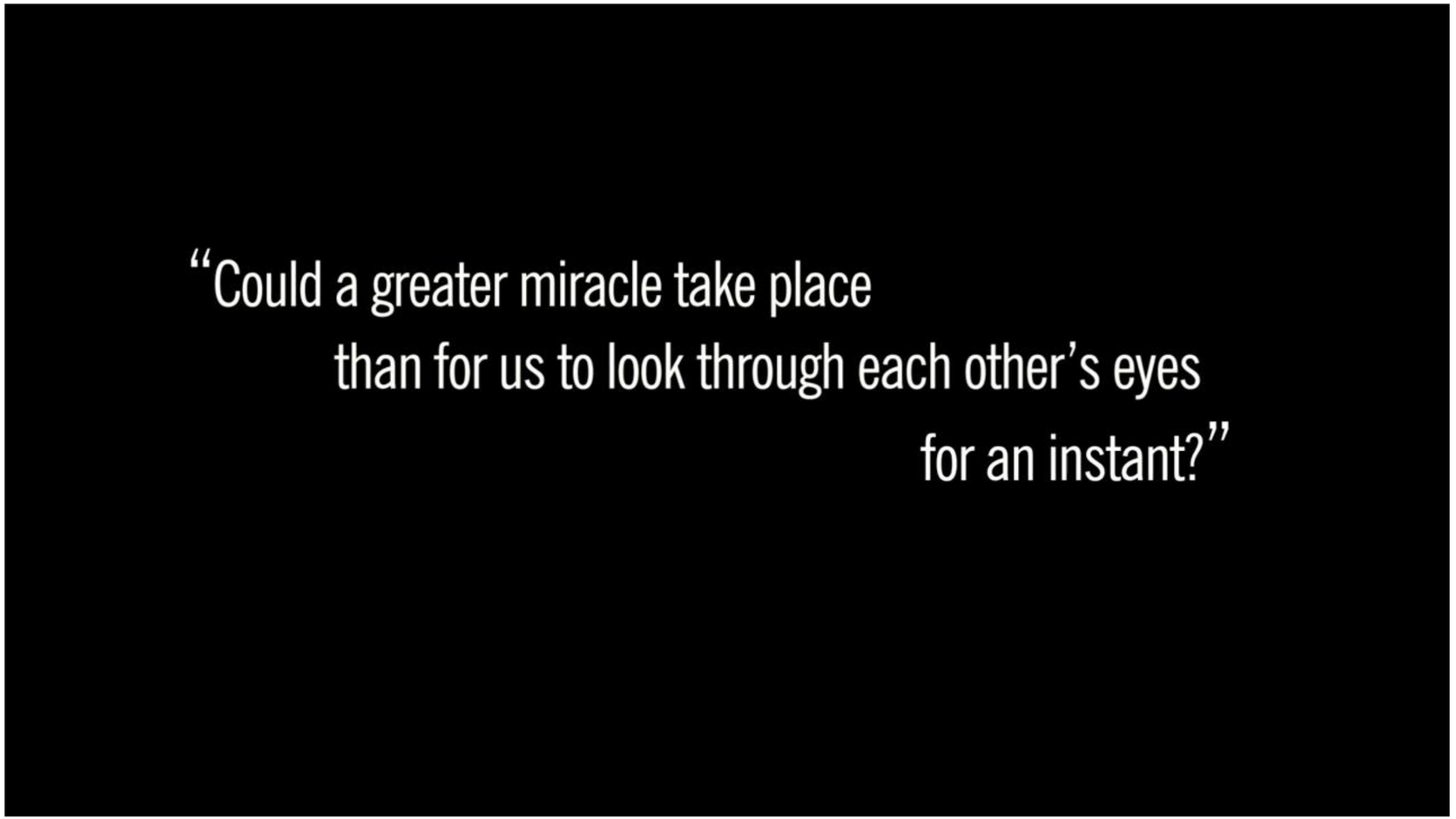
Using mobile ubiquity to facilitate disease management.

# Empathy


The ability to step into the shoes of another person, aiming to understand their feelings and perspectives, and to use that understanding to guide our actions.

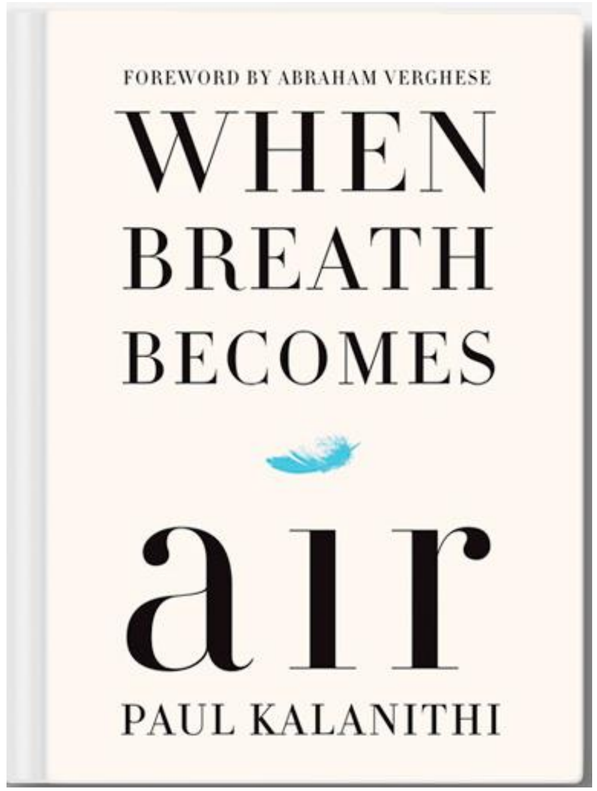
Understanding what others see, feel and experience.

# Empathy




Cleveland Clinic’s Empathy Series

# Empathy




http://www.medscape.com/viewarticle/865258

Once I had been diagnosed with a terminal illness, I began to view the world through two perspectives; I was starting to see death as both doctor and patient. As a doctor, I knew not to declare "Cancer is a battle I'm going to win!" or ask "Why me?" (Answer: Why *not* me?)

The book covers in some depth what it means to be a doctor. But it also has a special resonance for oncologists, as the author also describes his shock diagnosis, at 36 years of age, of metastatic lung cancer, and the transition from doctor to a patient facing his mortality.

*"[Doctors] trespass into sacred spheres.... They see people at their most vulnerable, at their most scared, their most private."*

Patient centricity

# Conclusions

1. THE WORLD HAS CHANGED AND NEW BUSINESS MODELS ARE CHALLENGING INCUMBENTS.
2. WE ARE IN THE MIDST OF THE 4TH INDUSTRIAL REVOLUTION.
3. THE RULES OF ENGAGEMENT IN HEALTHCARE HAVE CHANGED.
4. PATIENTS AND CAREGIVERS HAVE MORE POWER.
5. HEALTHCARE IS ALMOST COMPLETELY DIGITIZED.
6. THE RISE OF STANDARD AND EXTENDIBLE DATA-MODELS (FHIR – FAST HEALTHCARE INTEROPERABILITY RESOURCES) WILL ACCELERATE THE USE OF DATA FOR VALUE CREATION IN HEALTH.
7. EMPATHY IS THE ROOT OF VALUE CREATION AND THE ESSENCE OF HUMANITY.