

The **Future** of **Health** and **Medicine**: Where Can **Technology** Take Us?



DANIEL KRAFT, MD

Faculty Chair for Medicine, Singularity University
Executive Director, Exponential Medicine

 [@Daniel_Kraft](https://twitter.com/Daniel_Kraft)

Daniel@SingularityU.org



About Daniel Kraft M.D.



Daniel Kraft is a Stanford and Harvard trained physician-scientist, inventor, entrepreneur and innovator.

Dr. Kraft has over 20 years of experience in clinical practice, biomedical research and healthcare innovation. Daniel chairs the Medicine track for Singularity University and is Executive Director for FutureMed, a program which explores convergent, exponentially developing technologies and their potential in biomedicine and healthcare.

Following undergraduate degrees at Brown and medical school at Stanford, Dr. Kraft was board certified in the Harvard combined Internal Medicine and Pediatrics residency program at the Massachusetts General and Boston Children's Hospital, and completed Stanford fellowships in hematology/oncology & bone marrow transplantation, and extensive research in stem cell biology and regenerative medicine. He has been published in multiple scientific publications, including *Nature and Science*. He has patented medical device, immunology and stem cell related products through faculty positions with Stanford University School of Medicine and as clinical faculty for the pediatric bone marrow transplantation service at UCSF.

Dr. Kraft recently founded IntelliMedicine, focused on enabling connected, data driven, and integrated personalized medicine. He is also the inventor of the MarrowMiner, an FDA approved device for the minimally invasive harvest of bone marrow, and founded RegenMed Systems, a company developing technologies to enable adult stem cell based regenerative therapies.

Daniel is an avid pilot and serves in the California Air National guard as an officer and flight surgeon with an F-16 fighter Squadron. He has conducted research on aerospace medicine that was published with NASA, with whom he was a finalist for astronaut selection.



Faculty Chair
Medicine
SingularityU.org



Executive Director
[Exponential Medicine](#)



Founder
[Bioniq Health](#)

For a short online TEDTalk version of the Keynote to share with colleagues click on this link:

http://www.ted.com/talks/daniel_kraft_medicine_s_future.html

The screenshot shows the TED website interface. At the top left is the TED logo with the tagline "Ideas worth spreading". To the right is a navigation menu with links for Talks, Speakers, Playlists, Translations, TED Conferences, TED's Events, TED Prize, TED Fellows, TED Conversations, TED Community, TED-Ed, About TED, TED Blog, and TED Initiatives. Below the navigation is a search bar. A banner below the navigation promotes new TED Talks and includes a subscription form with "Daily" and "Weekly" options, and social media icons for Facebook, Twitter, and RSS. The main content area features the title "TALKS | TEDx" and "Daniel Kraft: Medicine's future? There's an app for that". Below the title is the video player showing Daniel Kraft on stage. To the right of the video player is the view count "575,281 Views" and a "Like" button with "13k" likes. Below the video player are buttons for "Embed", "Download", "Favorite", "Rate", and "Show transcript". At the bottom right, there is a "RELATED PLAYLISTS" section with a "NEW" badge and a "View more" link. Below that is a playlist titled "The future of medicine".

TALKS | TEDx
Daniel Kraft: Medicine's future? There's an app for that
FILMED APR 2011 • POSTED JUN 2011 • TEDxMaastricht

575,281 Views Like 13k

Daniel Kraft offers a fast-paced look at the next few years of innovations in medicine, powered by new tools, tests and apps that bring diagnostic information right to the patient's bedside. (Filmed at TEDxMaastricht.)

Daniel Kraft is a physician-scientist, inventor and innovator. He chairs the FutureMed program at Singularity University, exploring the impact and potential of rapidly developing technologies as applied to health and medicine. [Full bio »](#)

SINCE 1984, THE ROLEX AWARDS FOR ENTERPRISE HAVE SUPPORTED INDIVIDUALS WHOSE COURAGE AND CREATIVITY ADVANCE HUMAN KNOWLEDGE AND WELL-BEING.

ROLEX AWARDS FOR ENTERPRISE

RELATED PLAYLISTS **NEW** View more »

The future of medicine

The **Future** of **Health** and **Medicine**

Exponentially...

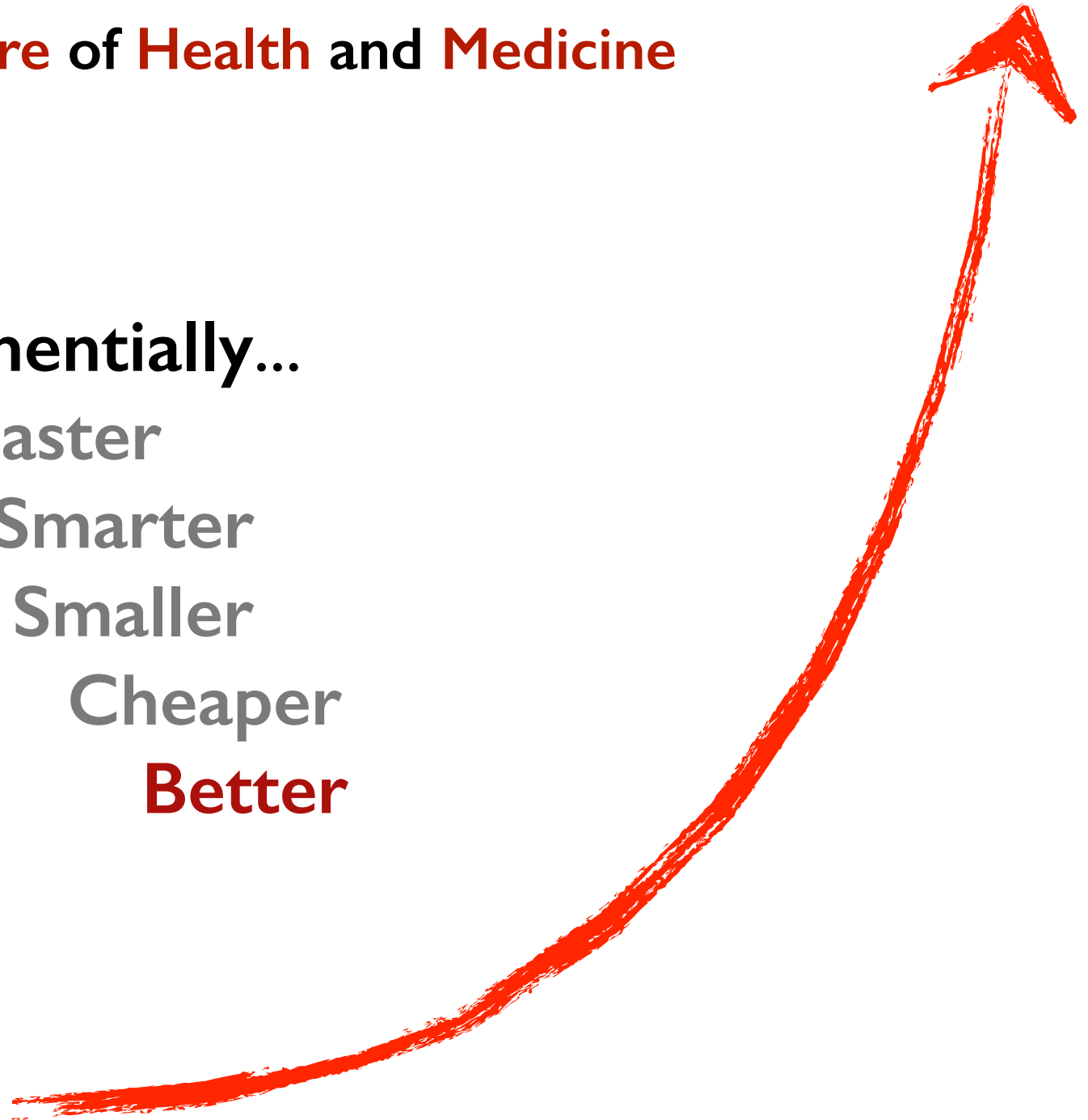
Faster

Smarter

Smaller

Cheaper

Better





Digital Medicine



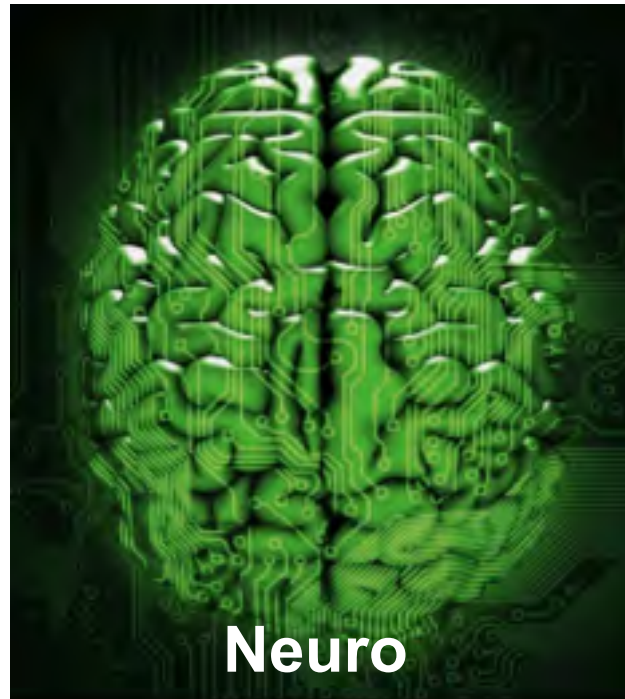
New Interventions



Nanomedicine



Genomics

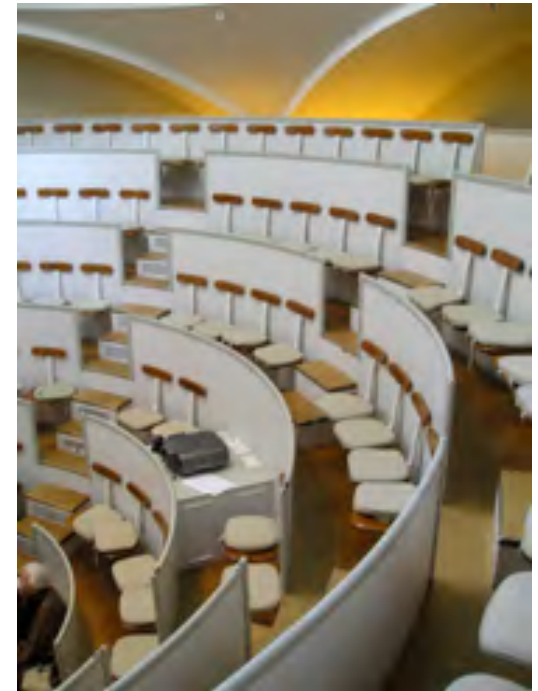


Neuro



Connected Health

Has the Practice of Medicine Changed much in over 100 years?



Old definitions and Divisions

Ophthalmology

Otolaryngology

Oncology

Radiology

Hematology

Gastroenterology

Urology

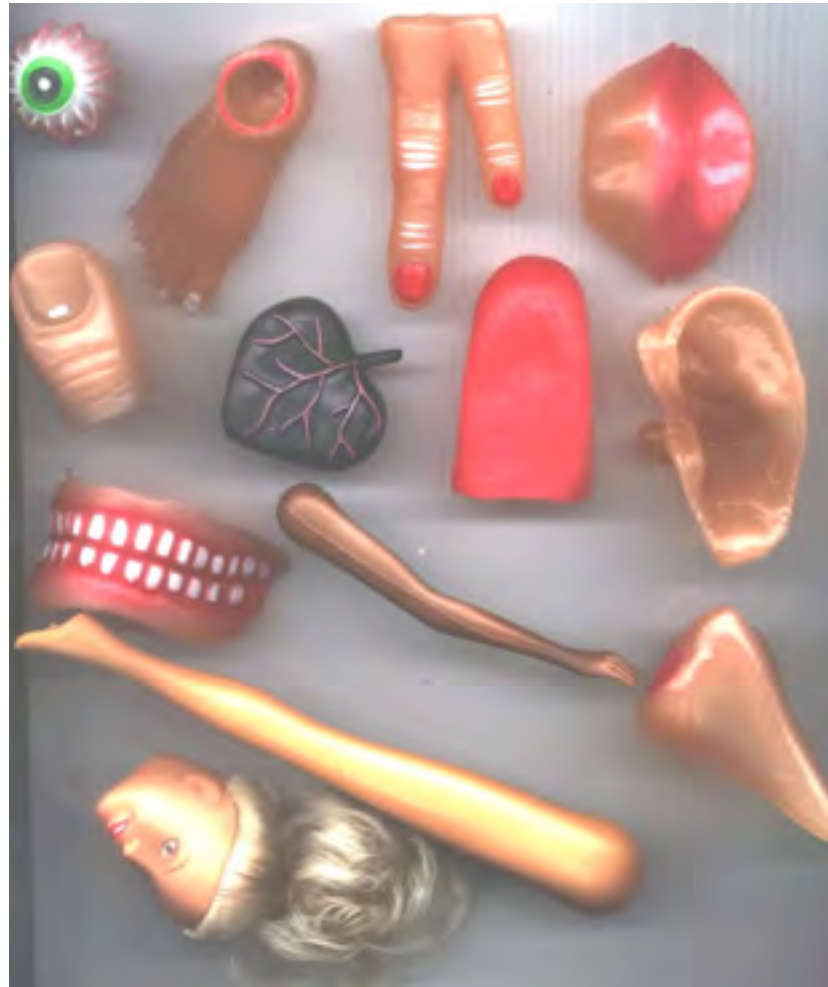
Cardiology

Neurology

Hepatology

Plastics

Dermatology



RE-IMAGINATION

THEN...

Dedicated Camera / Manually
Transfer Digital Files / Develop Films



THEN...



NOW...

(Instagr.am / Camera+ / Hipstamatic...)
Always With You Camera (Smartphone) /
Instant Digital Effects / Share / Sync / Discover



NOW...

(Amazon Kindle / Apple iBooks)



RE-IMAGINATION

THEN



NOW



disruption

Linear → Exponential



1996

Market cap of
\$28B

Revenue ~
\$16B

Employees
140,000



2012

Market cap
<\$100M

Revenue ~
\$6B

Employees
17,000

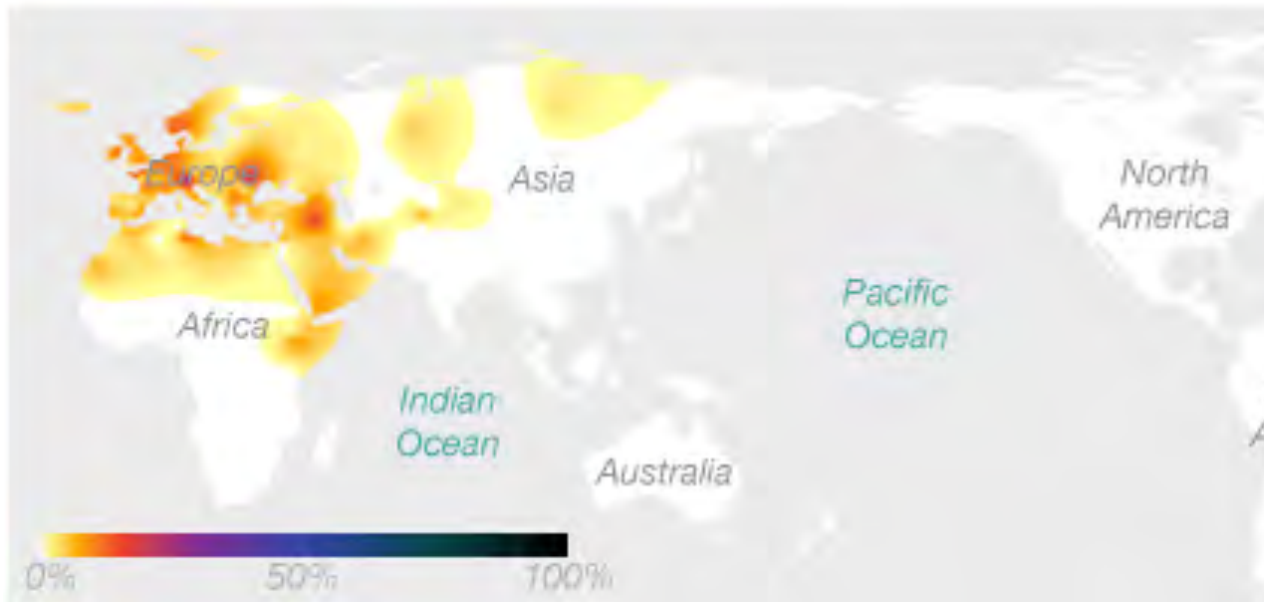


Facebook
Acquires
Instagram for \$1B

RE-IMAGINATION with PERSONAL GENOMICS

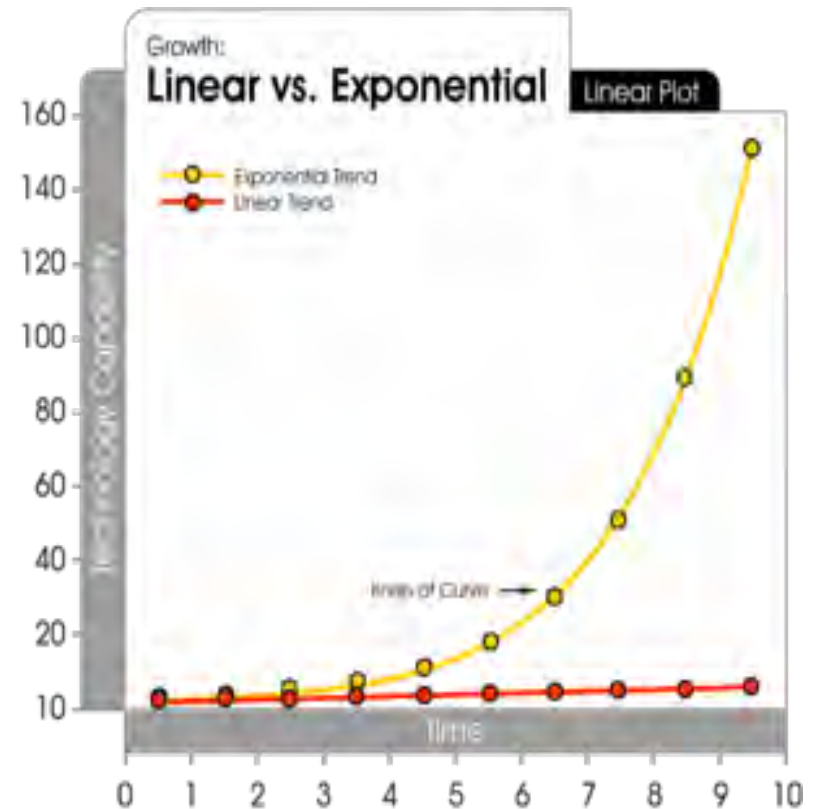


Mitochondrial DNA Haplotype K1a1b1a



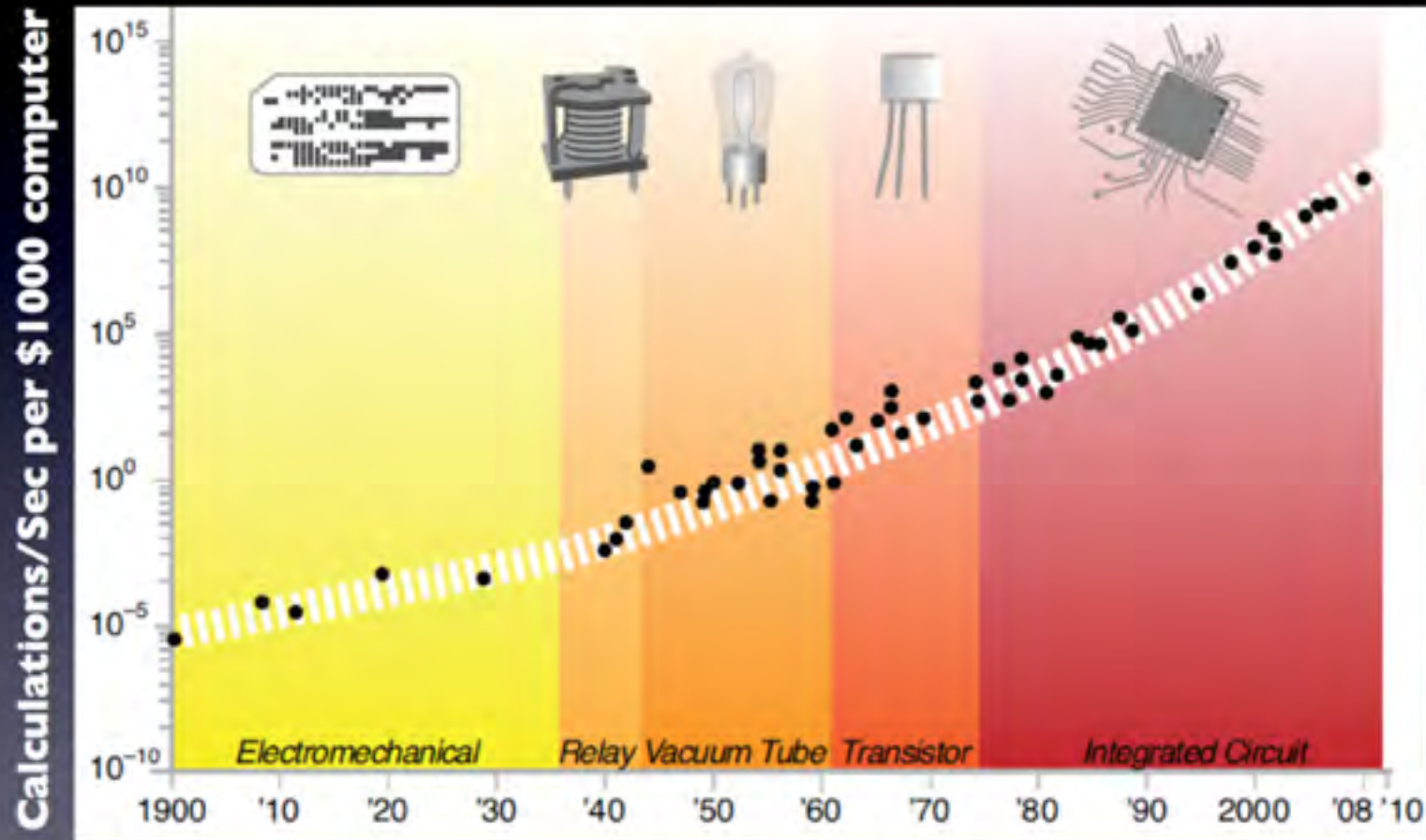
Leveraging Cross-Disciplinary Exponentially Growing Technologies

- Low-Cost Gene Analysis
- Computational Bio-Informatics
- High resolution Imaging
- Artificial Intelligence
- Internet Connectivity
- Mobile
- Social Networking
- Online T-Shirt Ordering

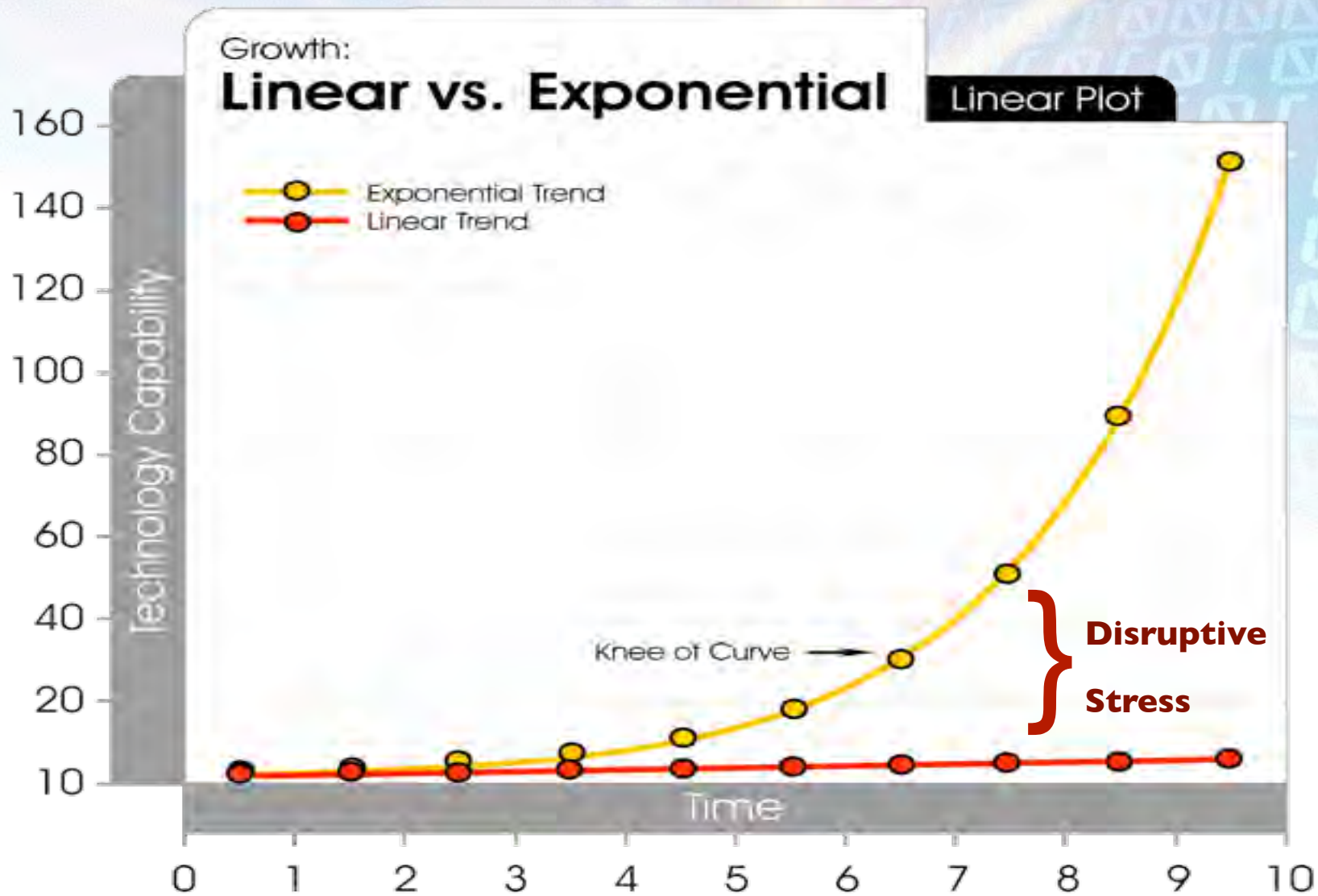


EXPONENTIAL GROWTH & THE LAW OF ACCELERATING RETURNS

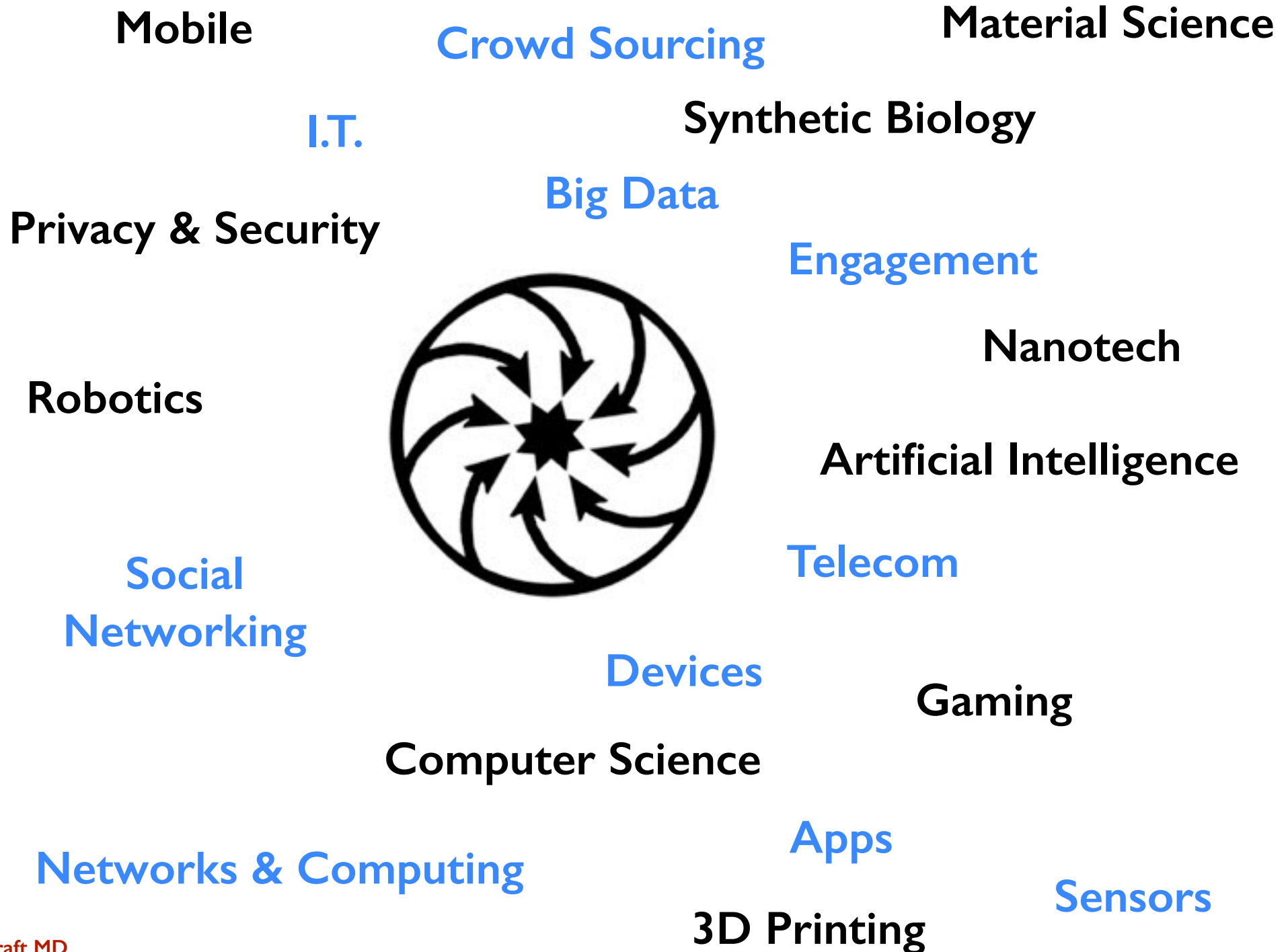
Moore's Law – 5th Paradigm of Exponential Growth



EXPONENTIAL GROWTH & THE LAW OF ACCELERATING RETURNS



CONVERGENCE of Many Fast Moving Technologies



New Information Layers



HTML (text)



Video



Social Profiles



Location

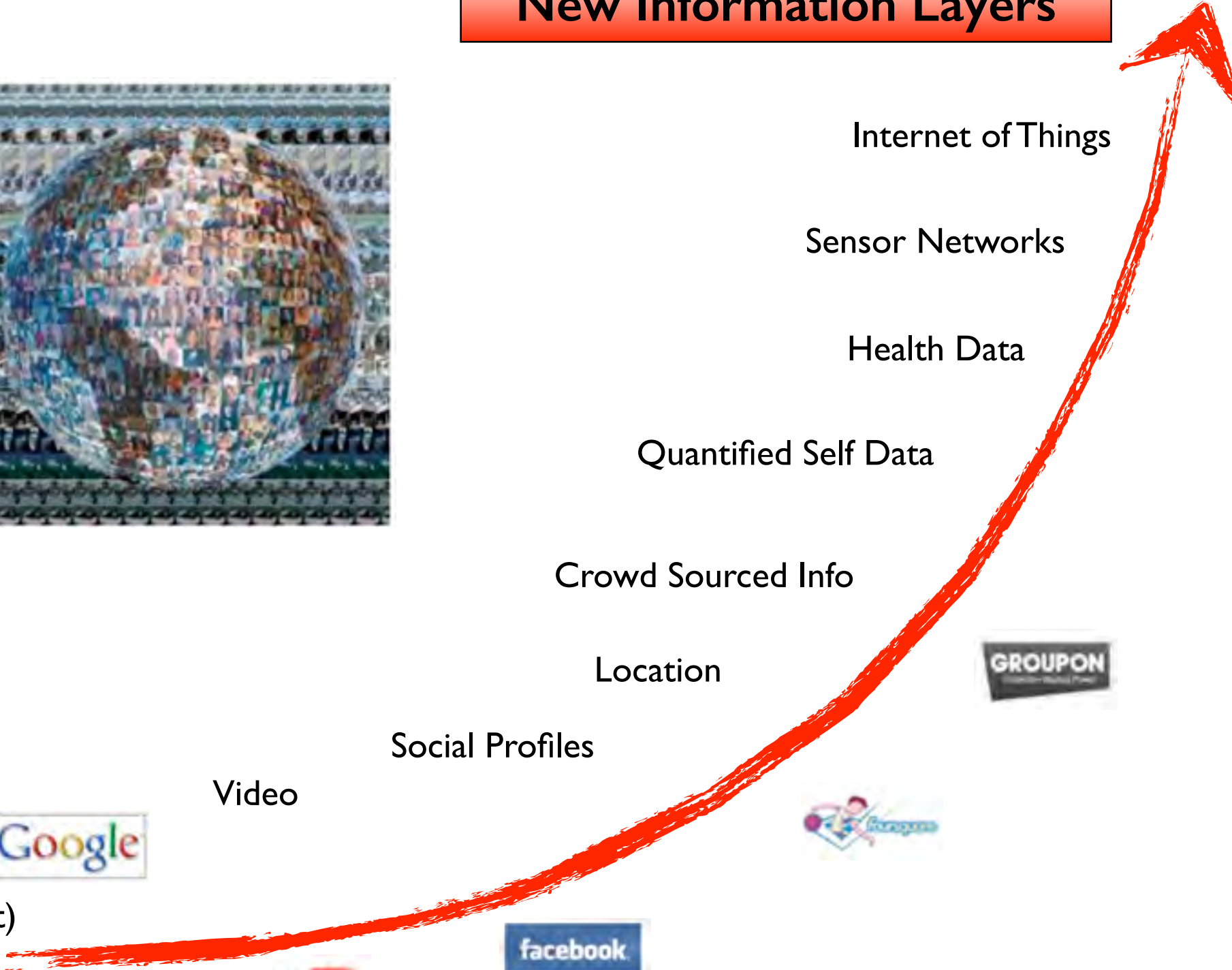
Crowd Sourced Info

Quantified Self Data




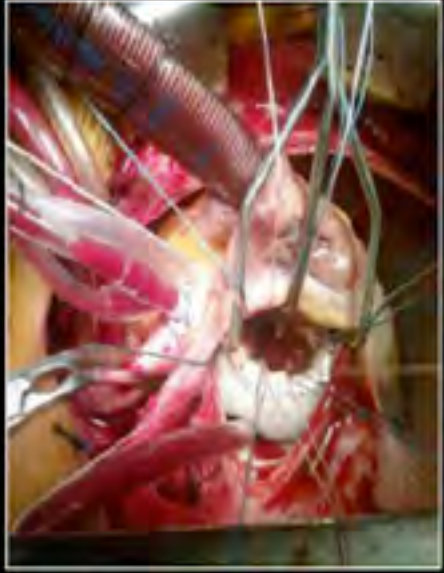



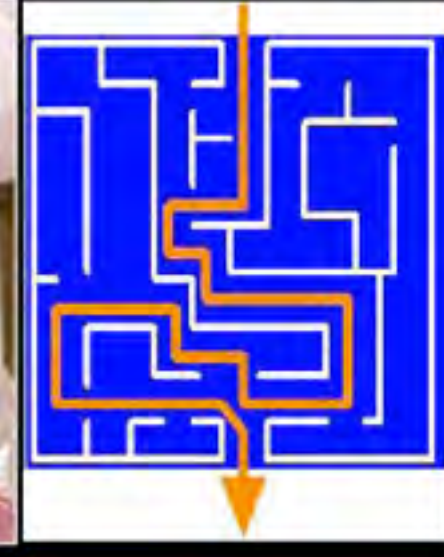
Health Data

Sensor Networks

Internet of Things

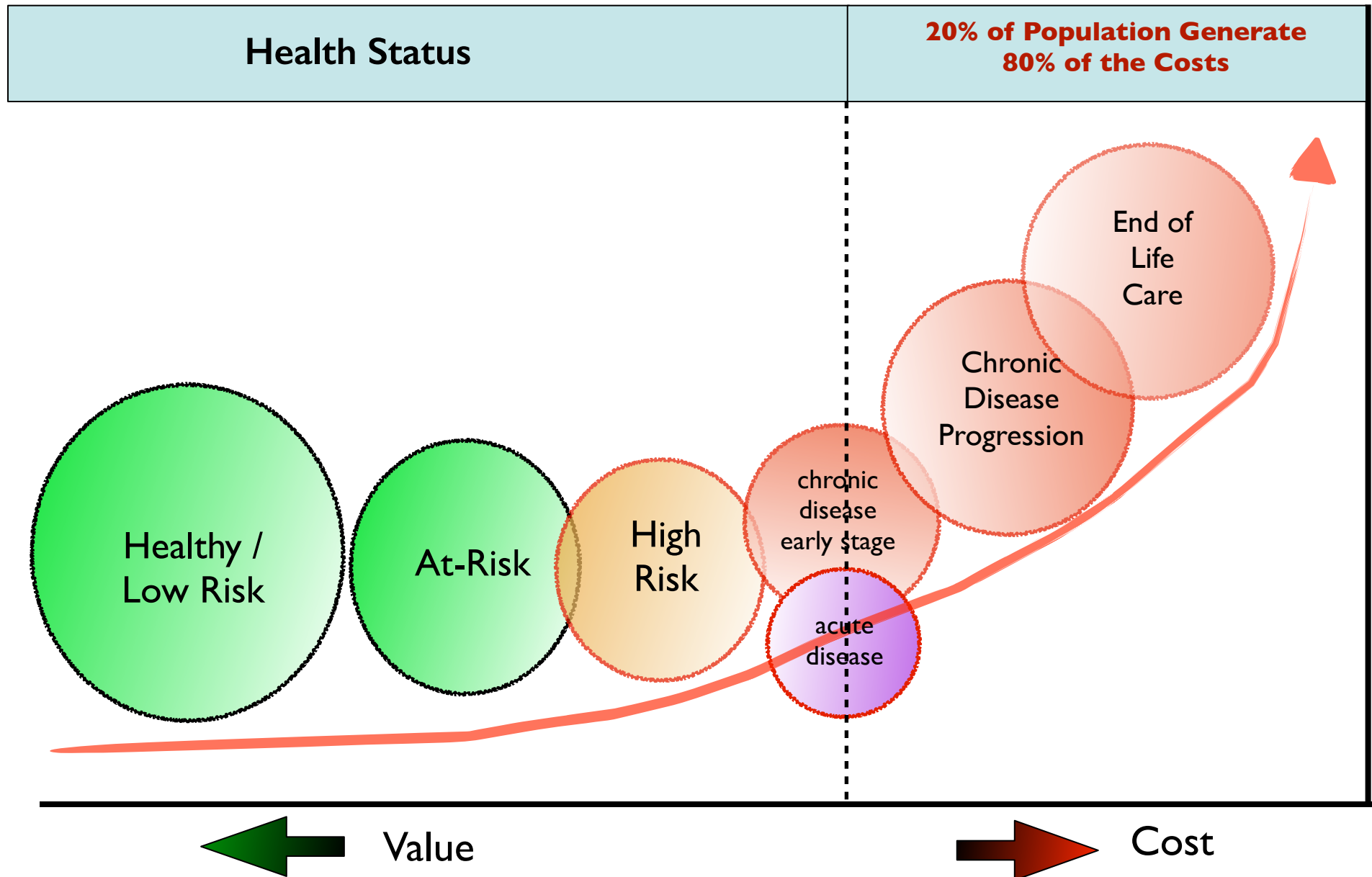


Major Challenges in Healthcare

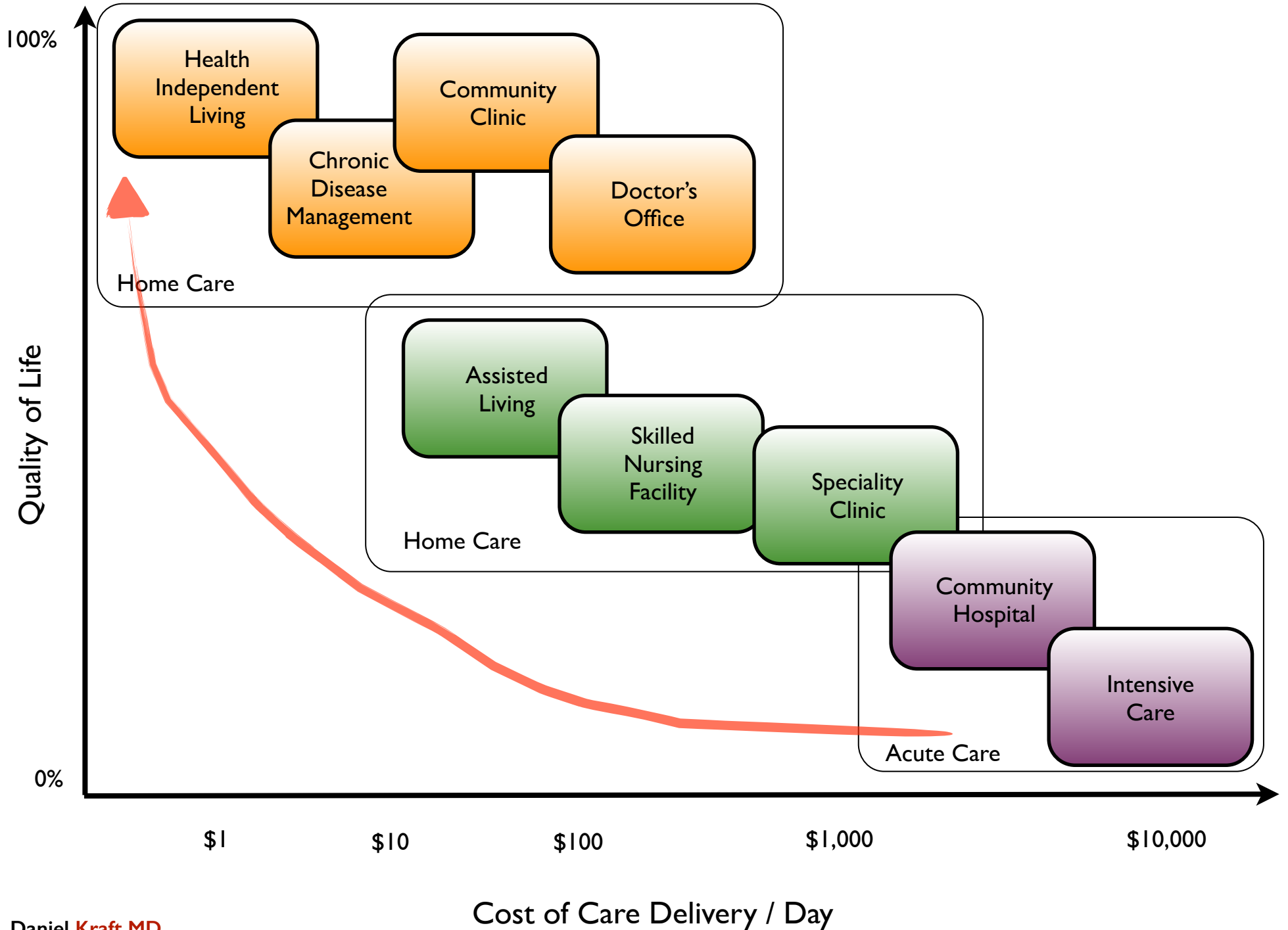
Cost	Demographics	Access	Variation in Clinical Practice
			
			
<p>Inefficient Use of Information</p>	<p>Fragmented Care Versus Integrated Care</p>	<p>Duplication, Defensive Medicine & Waste</p>	<p>Protracted Adoption of Innovation</p>

TRENDS: Moving to the **Left**

Benefits of Proactive Mitigation of Disease Risk



TRENDS: Where Healthcare Happens



New Players & Accelerators





Singularity University



Singularity University's mission is to educate, inspire and empower leaders to apply exponential technologies to address humanity's grand challenges.



AI & Robotics



Biotechnology
& Bioinformatics



Nanotechnology



Energy
& Environmental
Systems

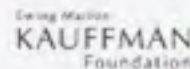
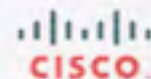
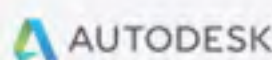


Medicine
& Neuroscience

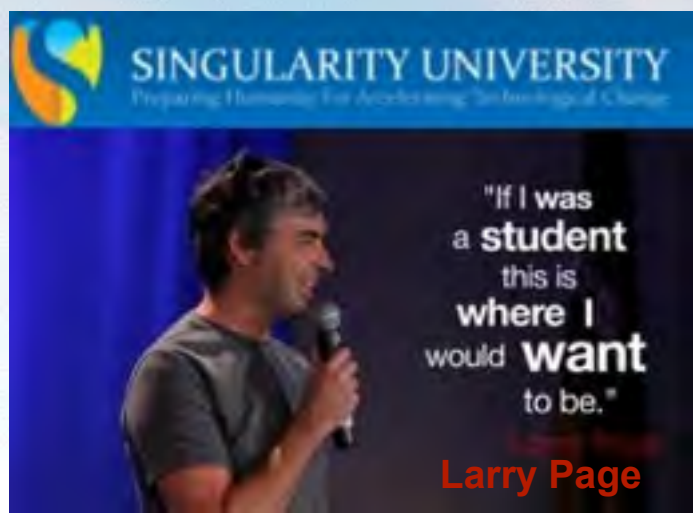


Networks
& Computing
Systems

CORPORATE FOUNDERS



SingularityU.org



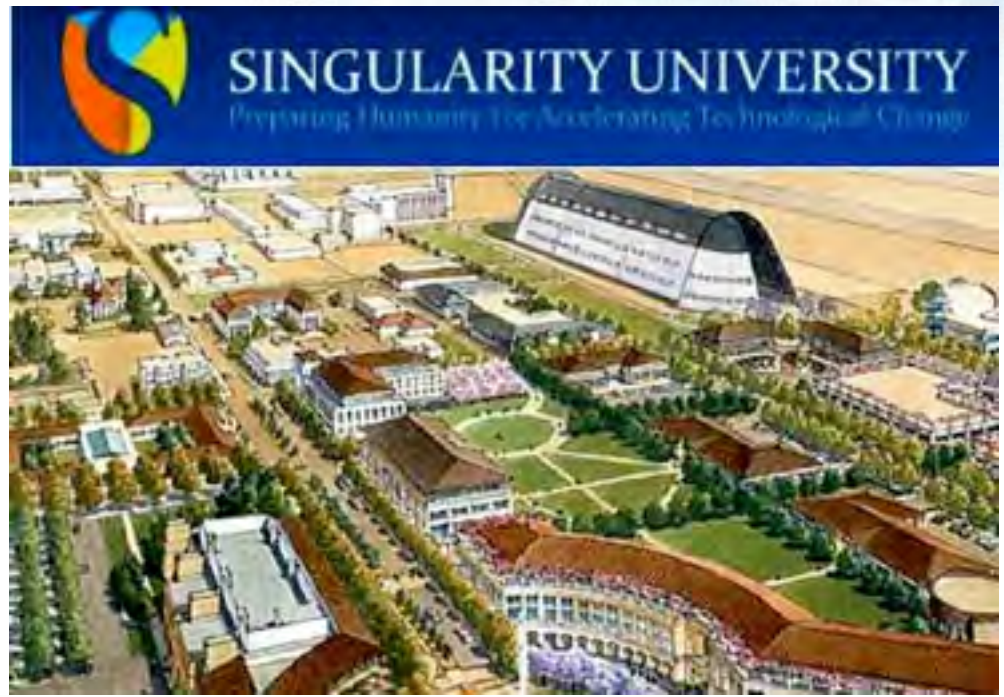
Understand and Leverage Fast Moving Technologies

On the NASA Ames Research Park Campus in Silicon Valley

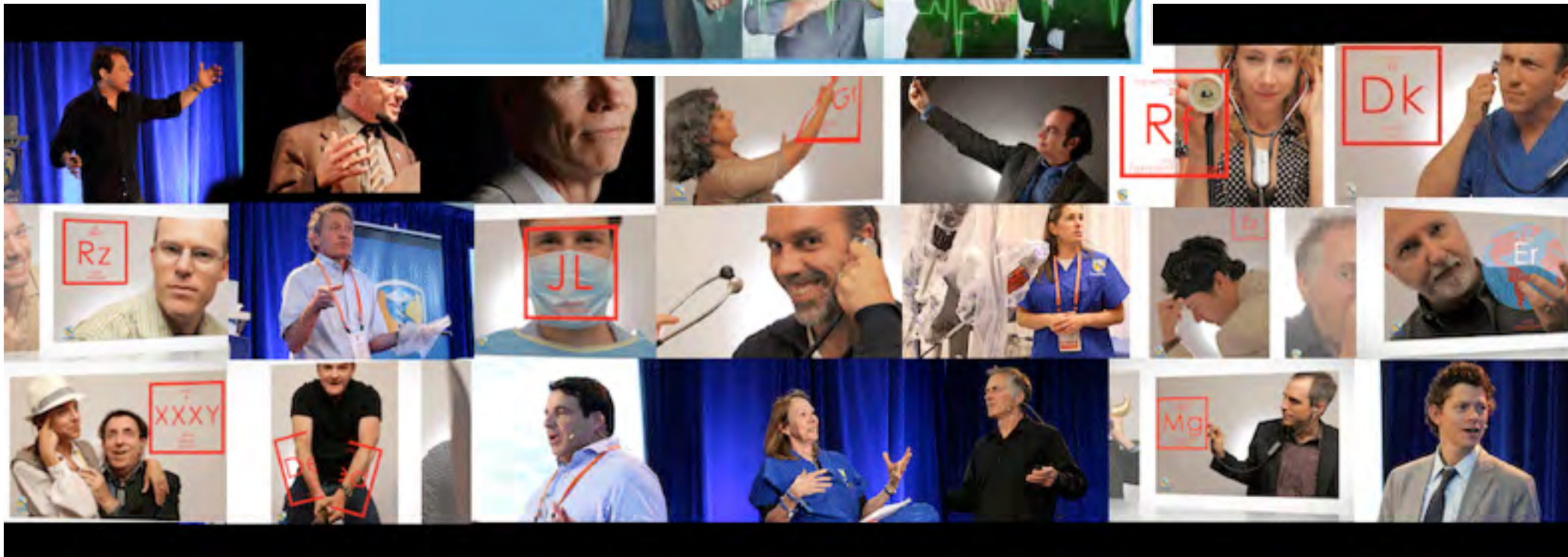
-10 week **Summer Graduate Studies Program**

-1 week **Executive Programs** - Accelerating change and understand how technology will impact their business. The growth opportunities and disruptive

-Custom **1-3 Day Corporate programs** - technology areas will impact their business. A 1-day workshop or custom program for



Click Here to see short
Intro Video



Exponential Medicine is a unique 4 day program bringing together thought leaders and innovators focused on understanding and leveraging fast moving technologies in Healthcare & BioMedicine

ExponentialMedicine.com



Come Shape the Future of Medicine
Join us in San Diego, CA November 9-12



"The ideas, the exchanges, the interaction with the people is just extraordinary."

-Dr. Marty Kohn, Chief Medical Scientist, IBM Watson



"I stay for the entire event because what happens on the stage is truly remarkable."

-John Mattison, CMIO, Kaiser Permanente



Next
**Exponential
Medicine**

Nov 9-11th
2014

Hotel Del Coronado,
San Diego



Apply Now to Participate: Spaces Limited
ExponentialMedicine.com

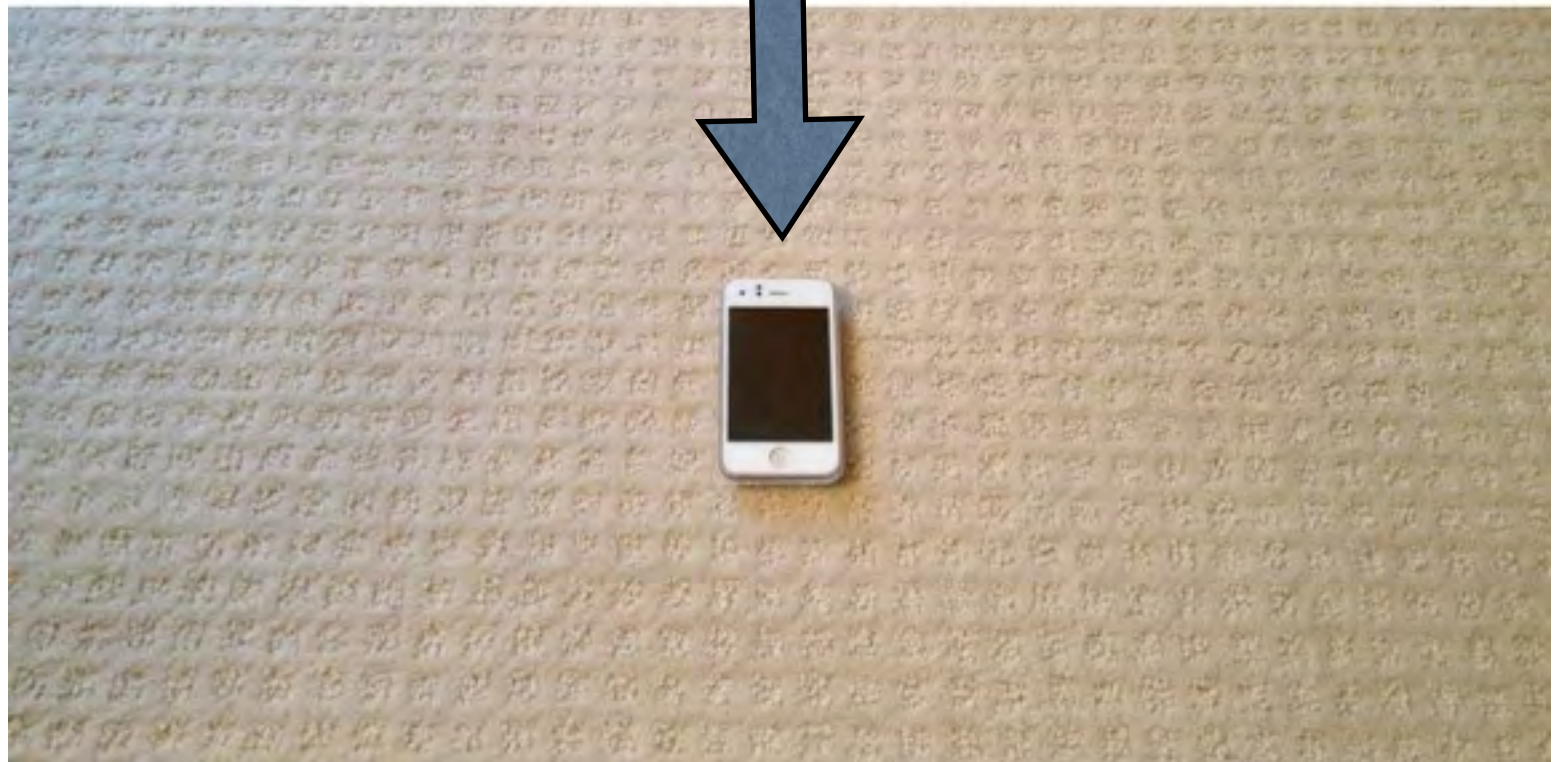
Mobile Health

WORLD POPULATION
6,852,472,823



MOBILE USERS
5,300,000,000





Health & Medical Apps



iBGStar

Glucose Meter integrated with iPhone



Trend Chart



Plots glucose readings from the Scorecards over time.

Logbook

A screenshot of the iBGStar app's Logbook. The screen shows a table of glucose readings. The table has columns for 'Breakfast', 'Lunch', 'Dinner', and 'Night', each with 'Pre' and 'Post' sub-columns. The data is as follows:

	Breakfast		Lunch		Dinner		Night	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
10:00 AM	111	142	105					
12:00 PM			89	97				
2:00 PM			107	100	115			118
4:00 PM								
6:00 PM								
8:00 PM								
10:00 PM								

The bottom of the screen shows the iPhone home button and dock.

At-a-glance view of glucose readings from Scorecards.

Statistics

A screenshot of the iBGStar app's Statistics screen. The screen shows a table of glucose statistics. The table has columns for 'Glucose', 'Average', 'Standard Deviation', and 'Total Tests'. The data is as follows:

Glucose	Average	Standard Deviation	Total Tests
All Results	136.2	60.9	18
Pre-Breakfast	106.5	15.8	3
Post-Breakfast	207.5	136.5	2
Pre-Lunch	153.5	80.5	4
Post-Lunch	98.0	5.7	2
Pre-Dinner	119.0	28.8	3
Post-Dinner	139.0	—	1
Night	199.2	73.1	3

The bottom of the screen shows the iPhone home button and dock.

Displays averages, standard deviation, and total tests for glucose readings from Scorecards.

Alerts



Provides hypo and hyper alerts when glucose readings are out of the normal range.

Cluster-Randomized Trial of a Mobile Phone Personalized Behavioral Intervention for Blood Glucose Control

CHARLENE C. QUINN, RN, PHD
MICHELLE D. SHARDELL, PHD
MICHAEL L. TERRIN, MD, MPH

ERIK A. BARR, BA
SHOSHANA H. BALLEW, BA
ANN L. GRUBER-BALDINI, PHD

OBJECTIVE—To test whether adding mobile application coaching and patient/provider web portals to community primary care compared with standard diabetes management would reduce glycated hemoglobin levels in patients with type 2 diabetes.

RESEARCH DESIGN AND METHODS—A cluster-randomized clinical trial, the Mobile Diabetes Intervention Study, randomly assigned 26 primary care practices to one of three stepped treatment groups or a control group (usual care). A total of 163 patients were enrolled and included in analysis. The primary outcome was change in glycated hemoglobin levels over a 1-year treatment period. Secondary outcomes were changes in patient-reported diabetes symptoms, diabetes distress, depression, and other clinical (blood pressure) and laboratory (lipid) values. Maximal treatment was a mobile- and web-based self-management patient coaching system and provider decision support. Patients received automated, real-time educational and behavioral messaging in response to individually analyzed blood glucose values, diabetes medications, and lifestyle behaviors communicated by mobile phone. Providers received quarterly reports summarizing patient's glycemic control, diabetes medication management, lifestyle behaviors, and evidence-based treatment options.

RESULTS—The mean declines in glycated hemoglobin were 1.9% in the maximal treatment group and 0.7% in the usual care group, a difference of 1.2% ($P < 0.001$) over 12 months. Appreciable differences were not observed between groups for patient-reported diabetes distress, depression, diabetes symptoms, or blood pressure and lipid levels (all $P > 0.05$).

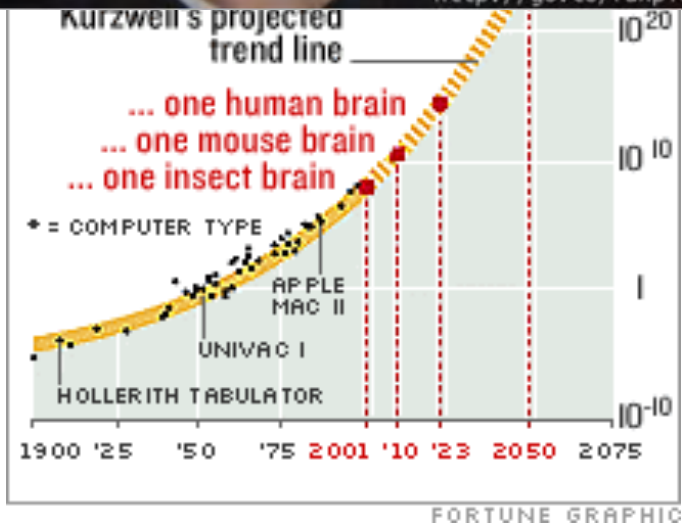
CONCLUSIONS—The combination of behavioral mobile coaching with blood glucose data, lifestyle behaviors, and patient self-management data individually analyzed and presented with evidence-based guidelines to providers substantially reduced glycated hemoglobin levels over 1 year.

interventions to assist patients and PCPs (12–14). The Mobile Diabetes Intervention Study, reported here, evaluated a diabetes-coaching system, using mobile phones and patient/provider portals for patient-specific treatment and communication. The hypothesis tested was that mobile telephone feedback on self-management of blood glucose results and lifestyle and clinical management offered to patients with type 2 diabetes and their providers can reduce glycated hemoglobin levels over 1 year.

RESEARCH DESIGN AND METHODS

Eligibility and study design

The Mobile Diabetes Intervention Study was a cluster-randomized clinical trial conducted in primary care practices in four distinct Maryland areas. Eligible practices included groups of at least three physicians without academic affiliation who provided diabetes care to at least 10% of their patients and were identified from a list of primary care practices in the study geographic areas. A detailed description of the study design was reported previously (13). Group assignment was concealed until a practice agreed to par-



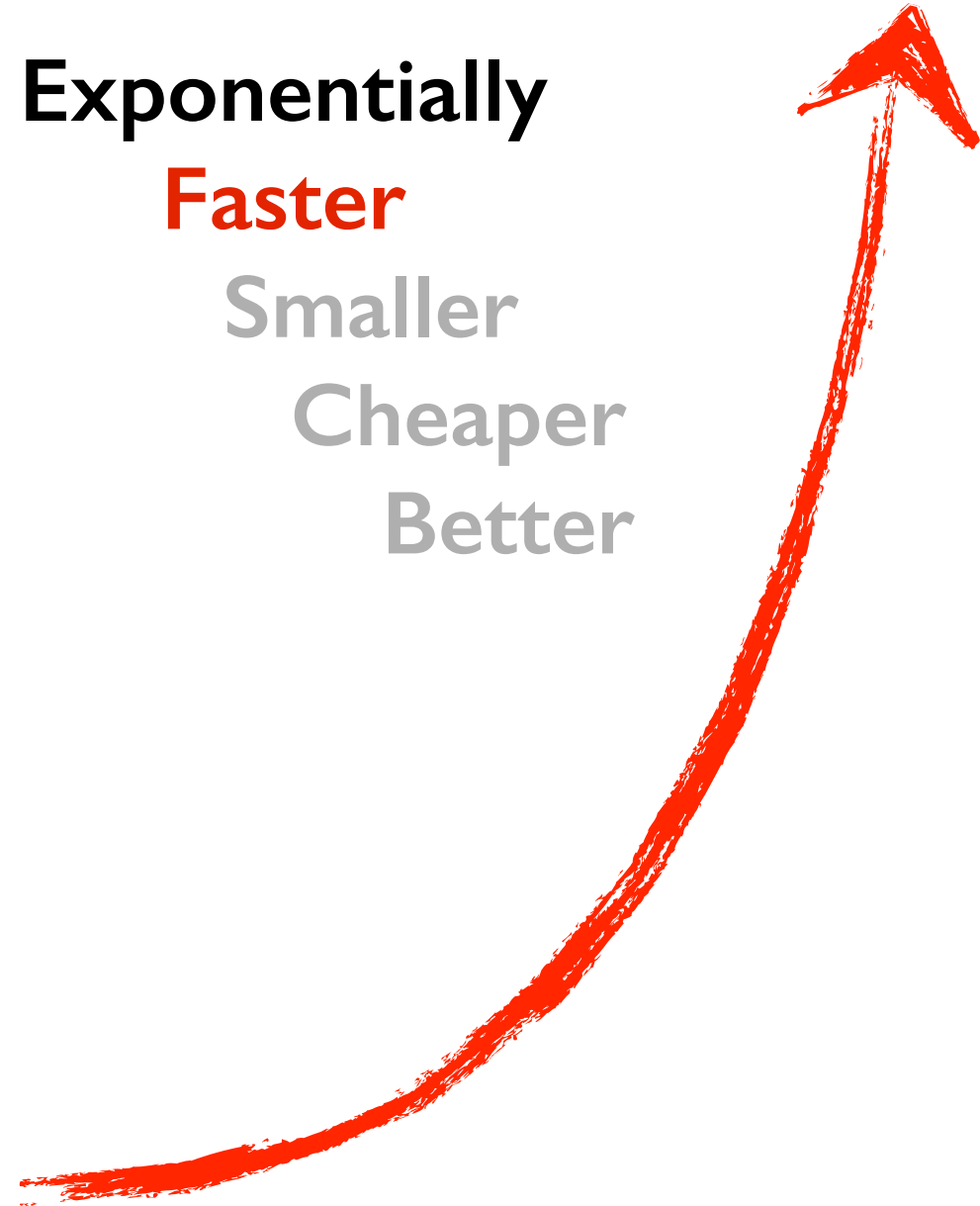
Exponentially

Faster

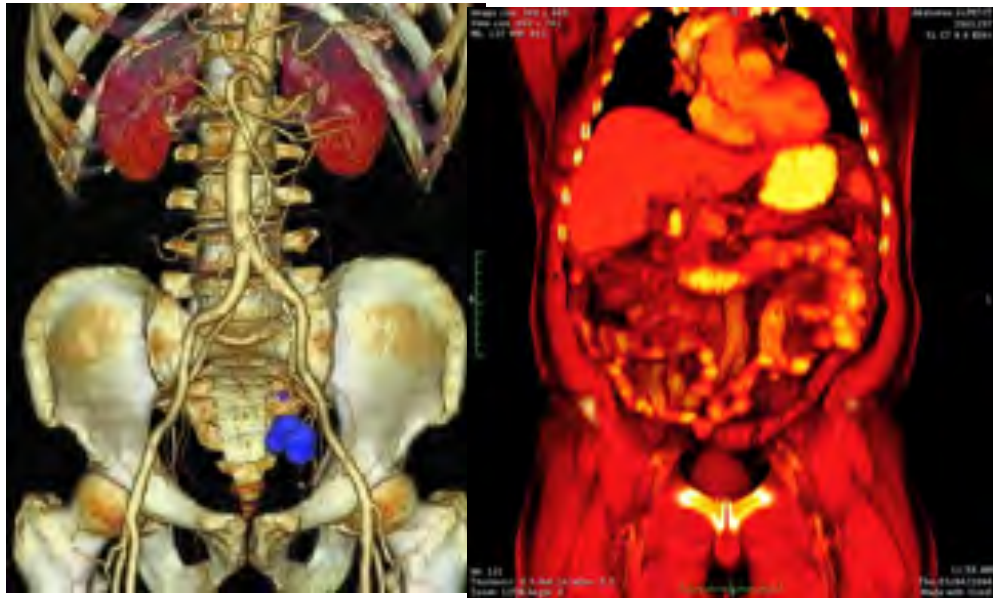
Smaller

Cheaper

Better

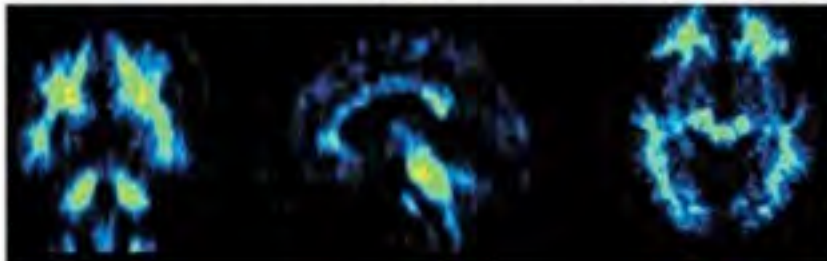


FASTER IMAGING: SPEED, RESOLUTION, RECONSTRUCTION...

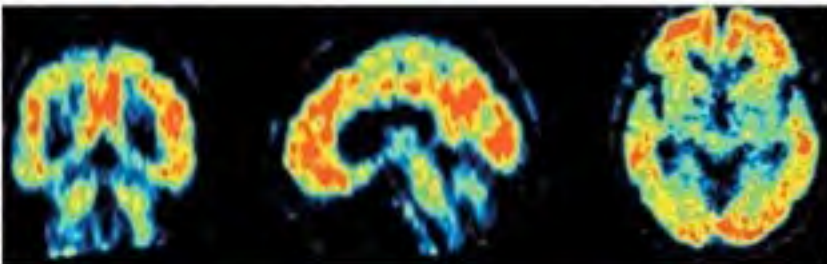


¹⁸F-AV-45 PET imaging of amyloid plaque

Elderly Control

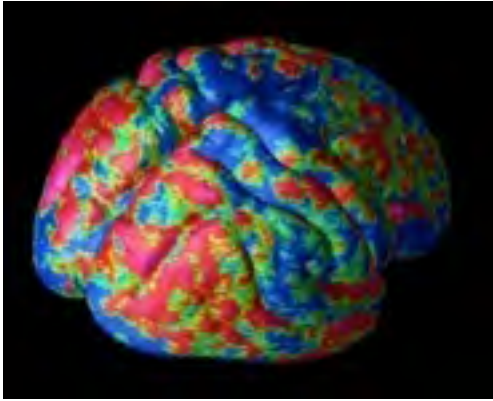


Alzheimer's disease



Data Explosion

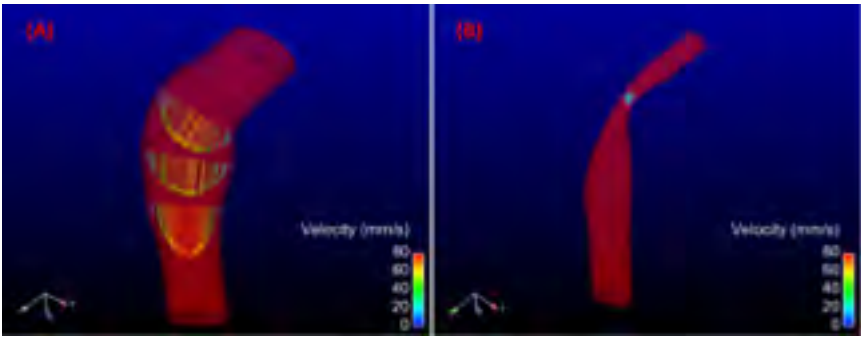
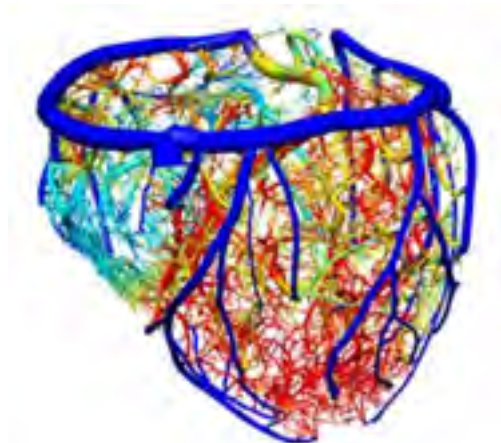
One Data Set, One Patient



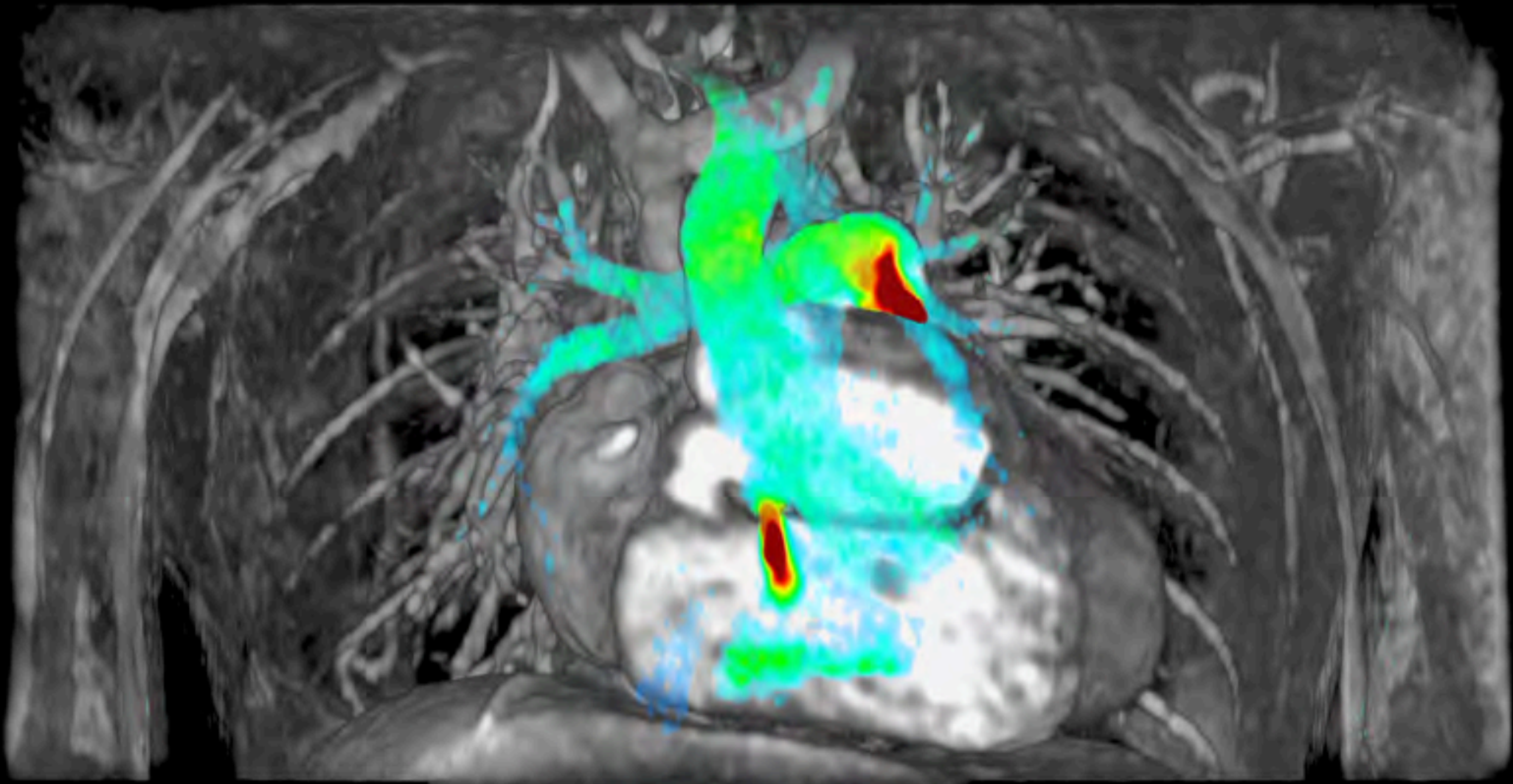
- Yesterday: 100 slices 512^2 pixels **50MB** or 50 books
- Today: 2400 slices 512^2 pixels **20GB** or 800 books
- Tomorrow 1024^3 voxels 100Hz, **1 Terrabyte** or 800,000 books



VIRTUAL ANGIOGRAM



VIRTUAL CARDIAC ECHO

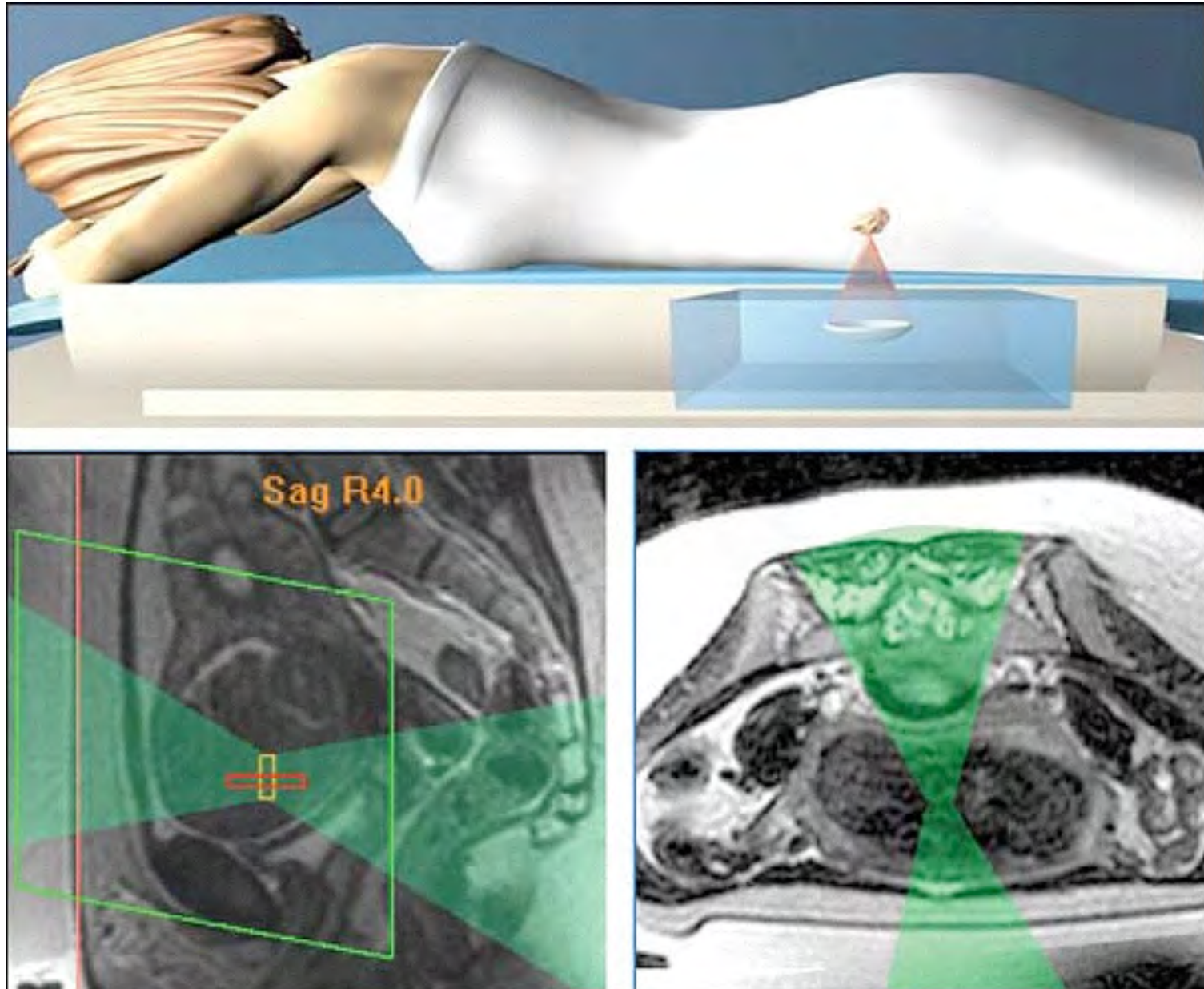


www.morpheusmedical.net

Morpheus Medical

CONVERGENCE

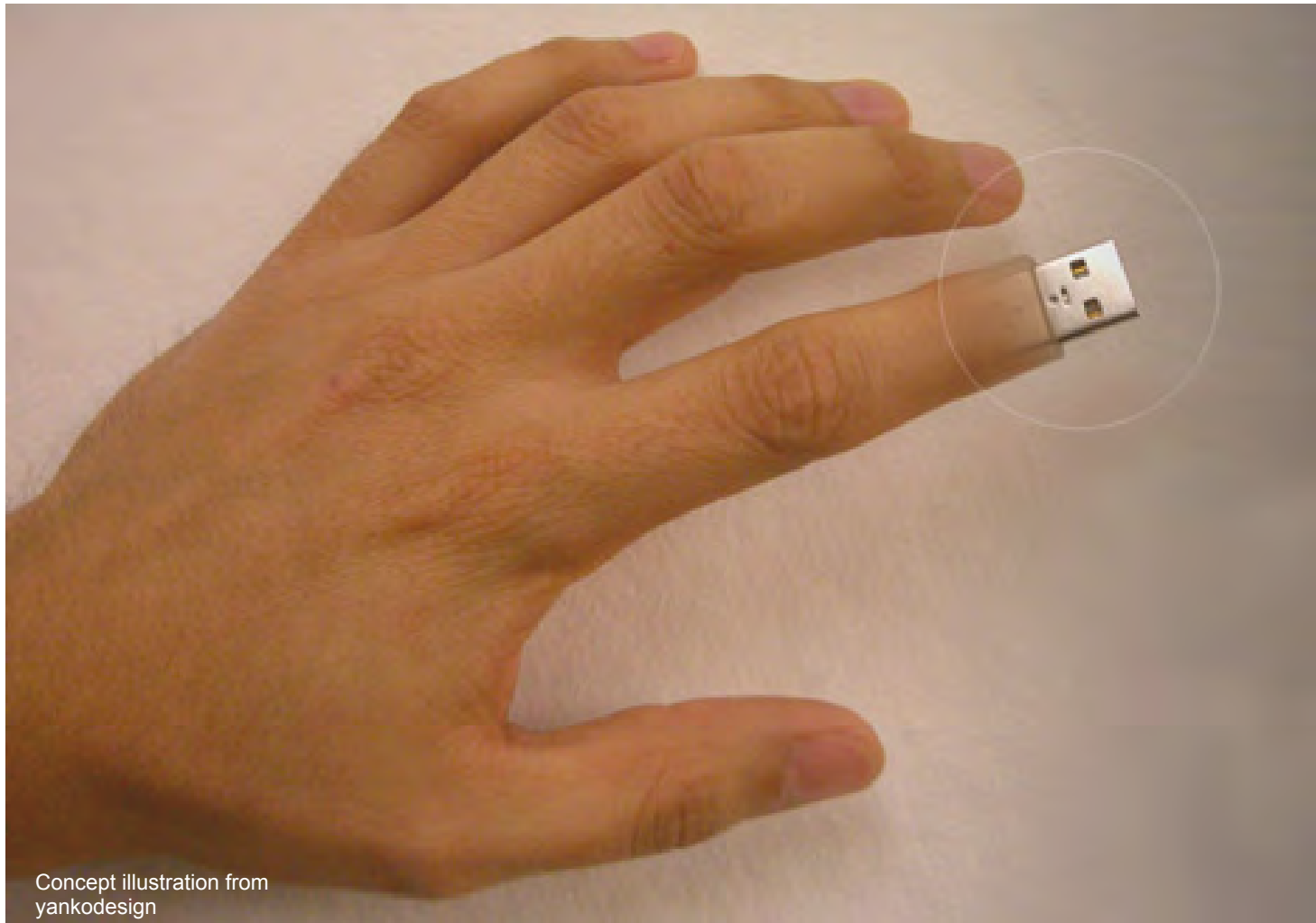
MR Guided Focused Ultrasound for Image Guided Robotic Acoustic Surgery (MRgFUS)



PARADIGM SHIFT: GOING DIGITAL...

Biomedicine + Information Technology + Wireless

mHealth: Digital - Mobile- Healthcare



Concept illustration from
yankodesign

Records



Exams



Labs



Vaccines



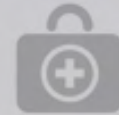
Rx



Drugs



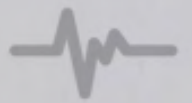
History



Environment



Vitals





AliveCor

Mobile Connected Phone EKG



The AliveCor Heart Monitor is cleared by the FDA for sale in the U.S. to licensed medical professionals and prescribed patients to record, display, store, and transfer single-channel electrocardiogram (ECG) rhythms.



Easy to use



Effective

EyeNetra TEST2CONNECT platform for eye care



mobile phone eye diagnostics



actionable data mobile app

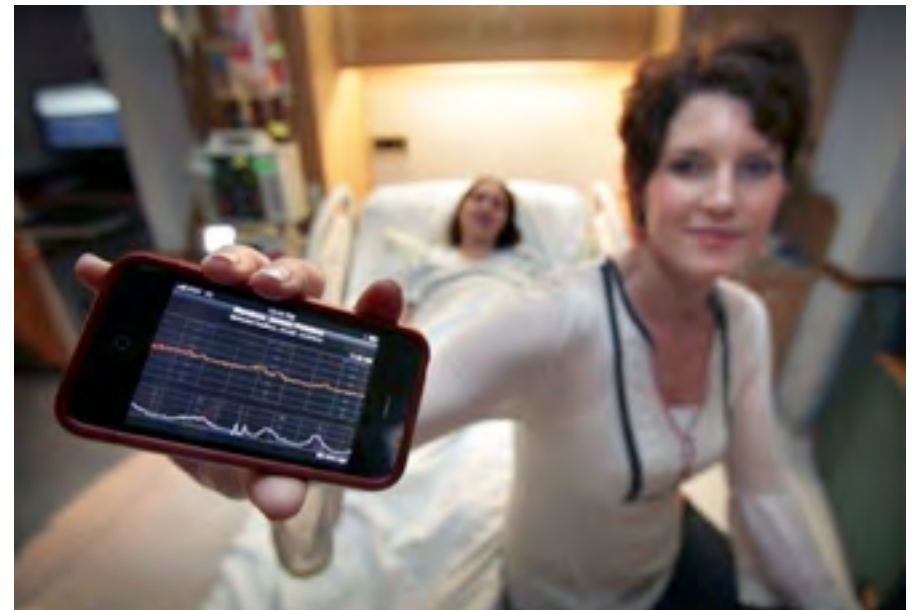


care providers via wireless network



EyeNetra.com

Medical Records Going Electronic



A \$35 Tablet...



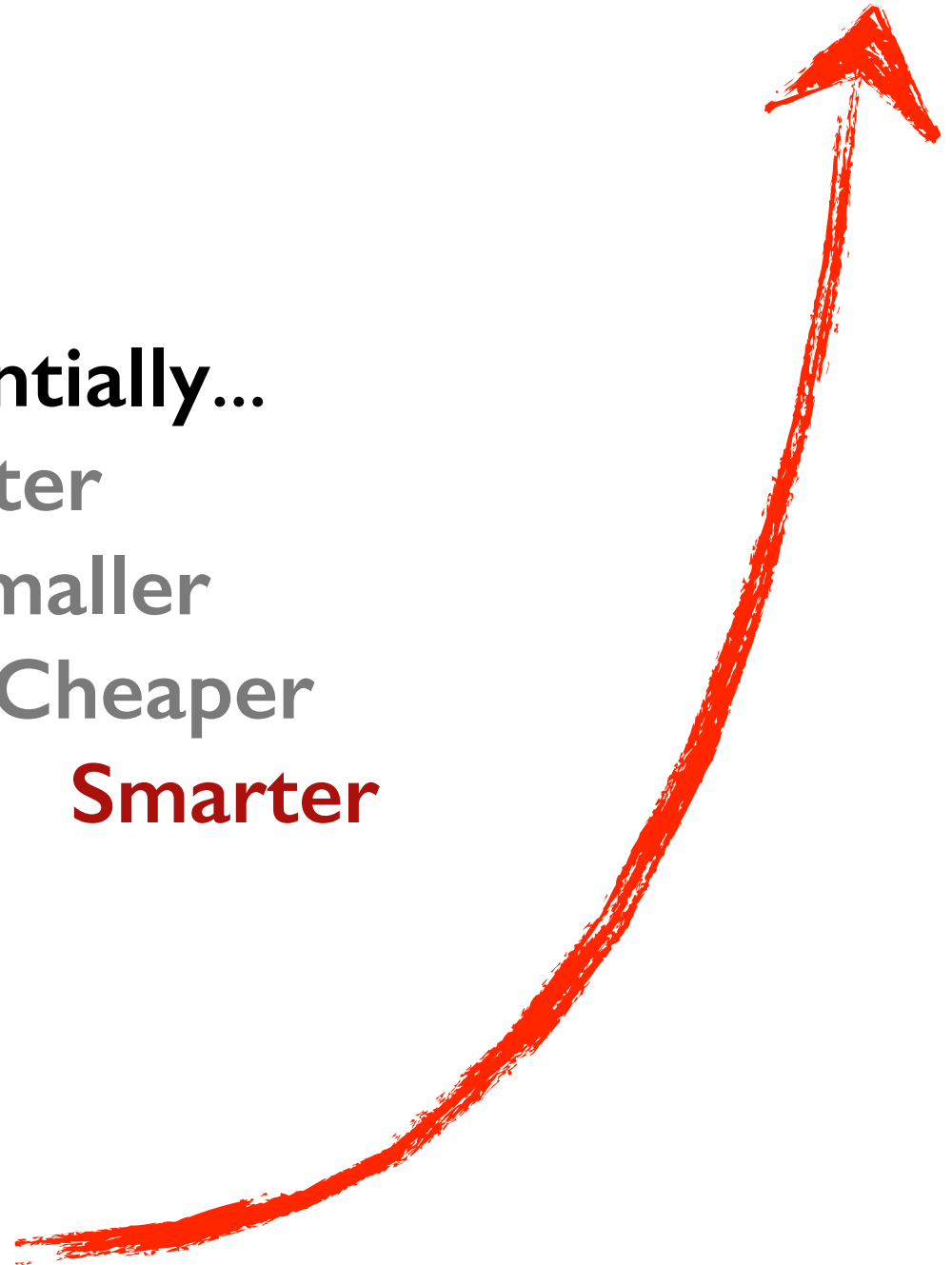
Exponentially...

Faster

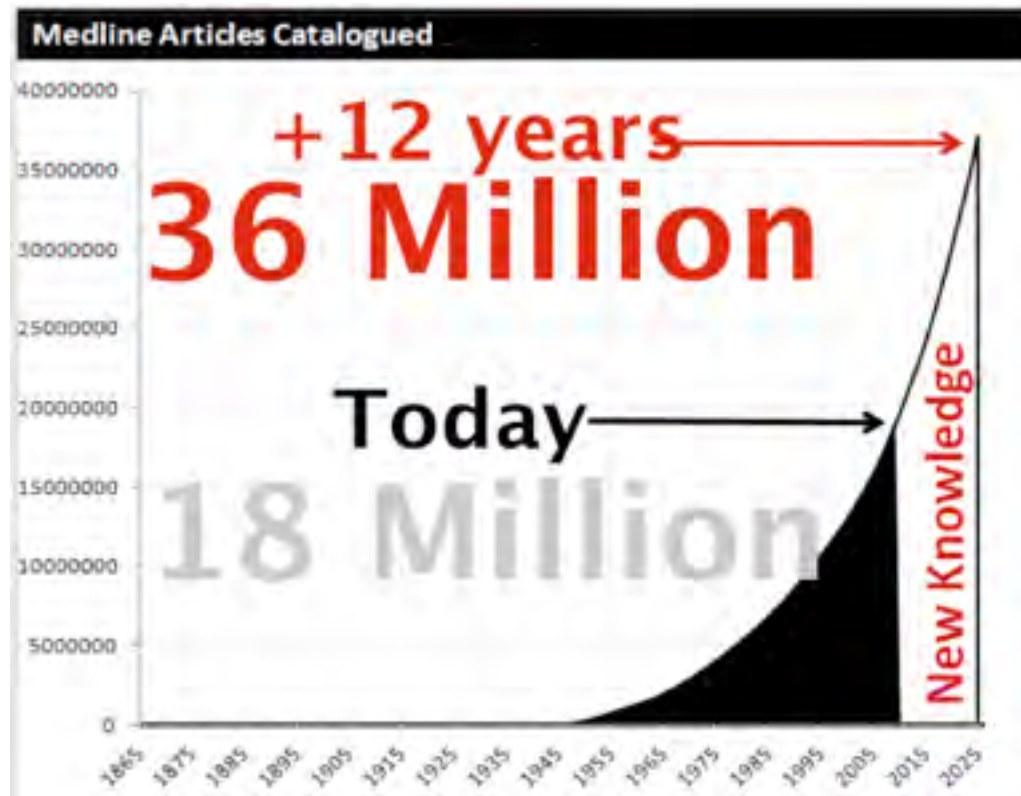
Smaller

Cheaper

Smarter



TMI: Too much information



“The complexity of modern medicine exceeds the capacity of the unaided human mind.” David Eddy, MD



Artificial Intelligence...

Imagine when the Power of 'Watson' is Available as an
AI Physician

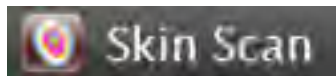
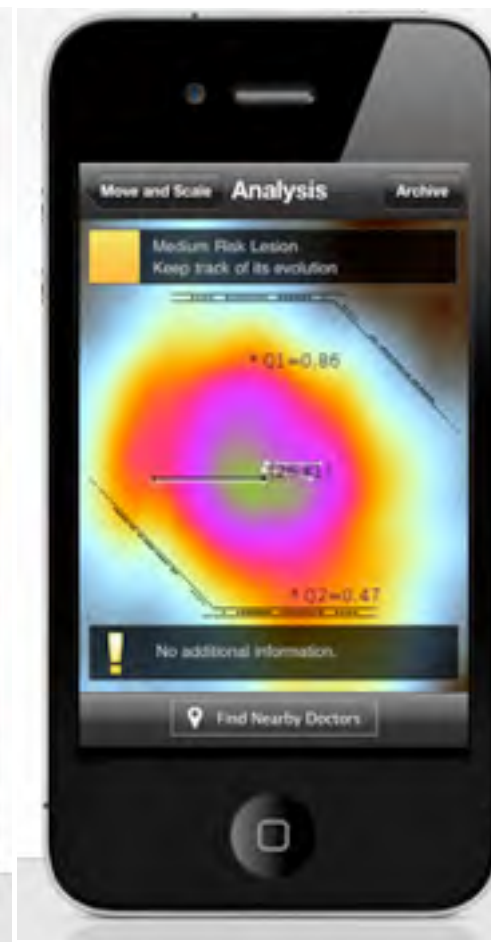
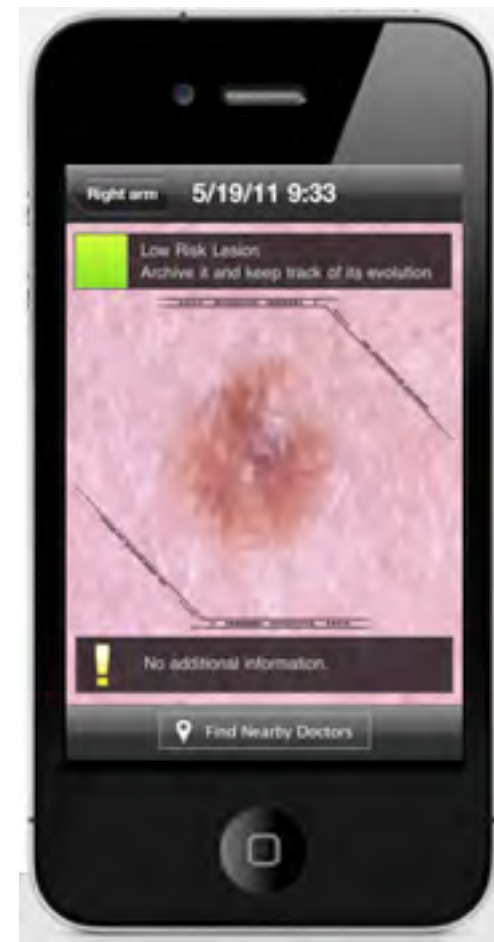
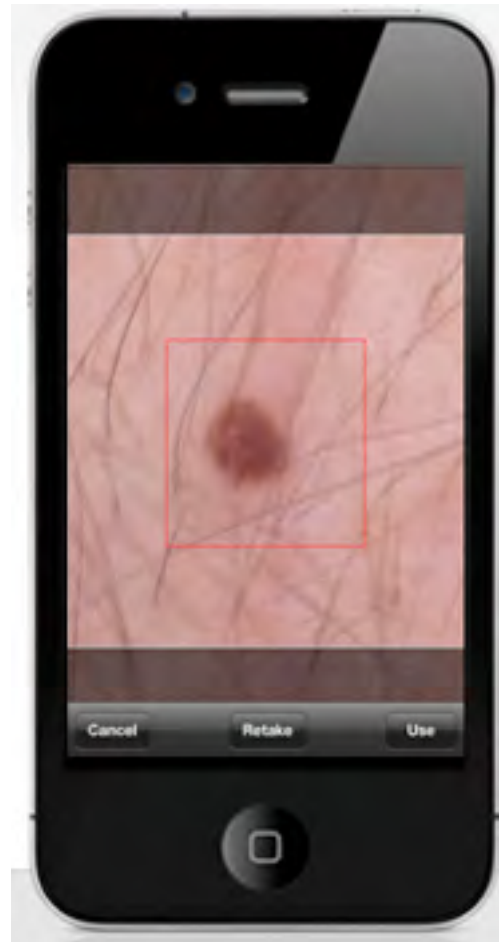
IA... Intelligence Augmentation

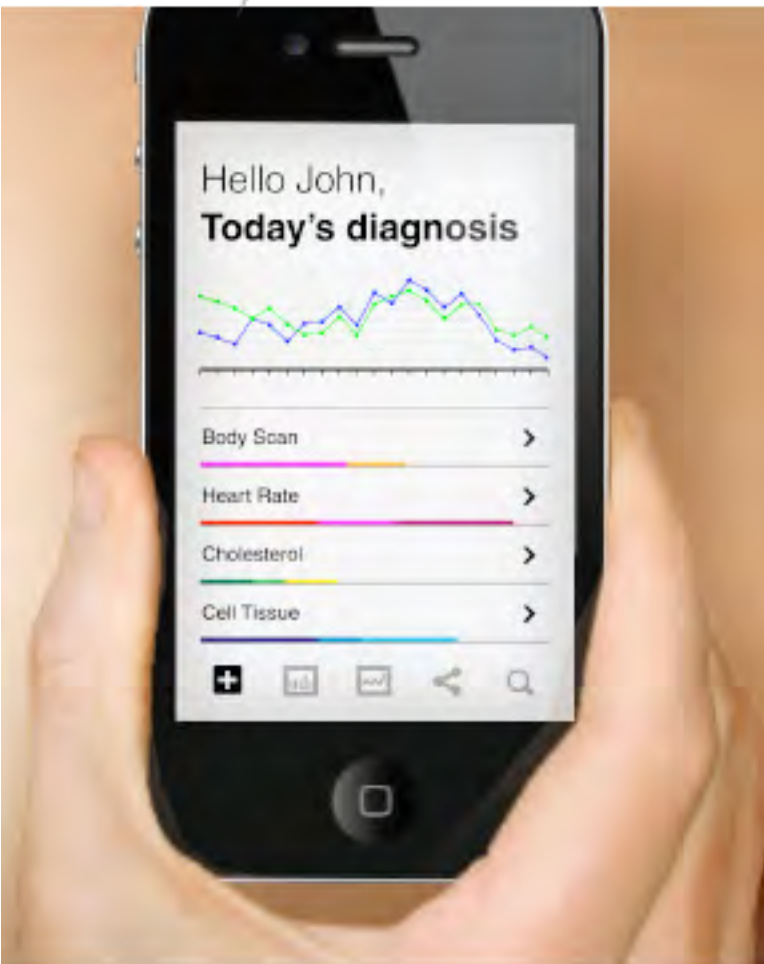




"In Brazil and India, machines are already starting to do primary care, because there's no labor to do it. They may be better than doctors. Mathematically, they will follow evidence—and they're much more likely to be right."

A.I. Machine Learning Based Apps: for helping diagnose dermatology issue (i.e. Melanoma)





Artificial Intelligence Physician



IV



Tricorder Team: Scanadu (started at Futuremed 2011)

SCANADU



Diamond Concept Device

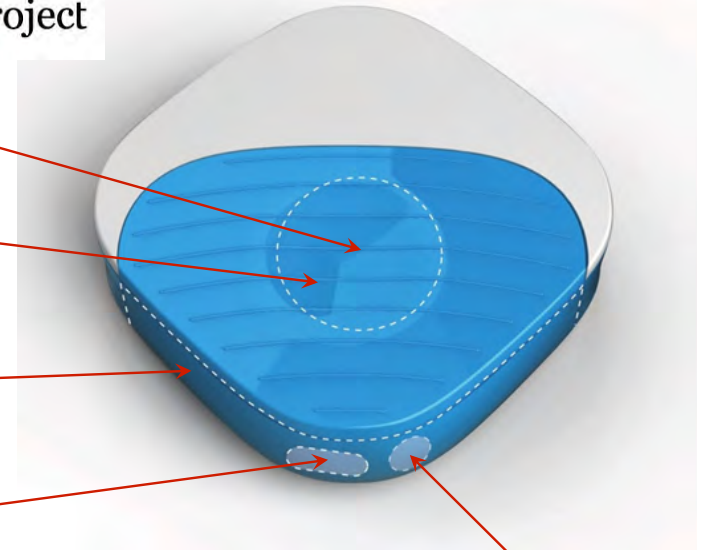
fuseproject

Piezo-ceramic
Stethoscope

Electrocardiograph
(ECG Sensor
Positive Electrode)

Electrocardiograph
(ECG Sensor
Negative Electrode)

Photoplethysmograph
(PPG Sensor)



60 mm

Infrared Thermometer



Smart Point of Care Testing



Influenza Testing



Scanaflo - Urinalysis



Scanadu Scout, the first Medical Tricorder

A scanner packed with sensors designed to read your vital signs and send them wirelessly to your smartphone in a few seconds, any time, anywhere.

Technology – Mountain View, California, United States

[Campaign Home](#)[Updates / 11](#)[Comments / 436](#)[Funders / 6005](#)[Gallery / 10](#)

Scanadu Scout™ - The first medical Tricorder



\$1,176,754

Raised of \$100,000 Goal

27 days left

Flexible Funding campaign

CONTRIBUTE NOW

This campaign will receive all of the funds contributed by Sat 20 Jul 11:59PM PT.

Select a Perk *for your contribution*

TeleMedicine & TelePharmacy Expanding Access with Virtual Visits



Using Mobile Devices to Enable Exams

SmartphonePhysical.org

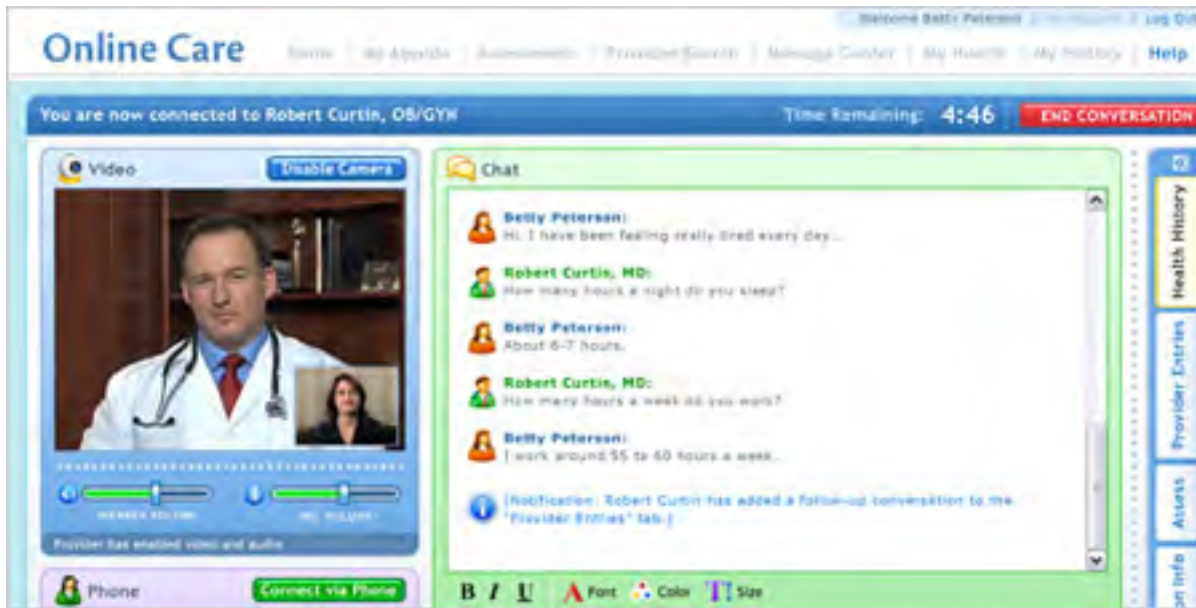
- [Body analysis](#) using an iHealth Scale.
- Blood pressure reading using a [Withings BP Monitor](#).
- Oxygen saturation/pulse [Masimo iSpO2](#) placed on the finger.
- Visual acuity via an [EyeNetra](#) phone case.
- Optic disc visualization using a [Welch Allyn iExaminer](#)
- Ear drum visualization with a [CellScope](#) phone case.
- Lung function using a [SpiroSmart Spirometer](#) app
- Heart electrophysiology using the [AliveCor Heart Monitor](#).
- Body sounds: A [digital stethoscope](#) from ThinkLabs
- Carotid artery visualization using a [Mobisante probe](#).



TeleMedicine & TelePharmacy Expanding Access with Virtual Visits



VIRTUAL VISITS & TELEMEDICINE via Tables/SmartPhones



AmericanWell.com



TelePresence: TeleRobotics



InTouch RP-7



Low Cost = \$1,500 and *Modular* Design



fellowrobots.com
SingularityU.org/labs

fellow
ROBOTS



TelePresence MedSensation Glove:

2012 Singularity University Team Project led by Harvard Medical Student now funded and being developed



- **Pressure**
- **Vibration**
- **Ultrasound**



- **Microphone**
- **Accelerometer**
- **Flow Sensor**



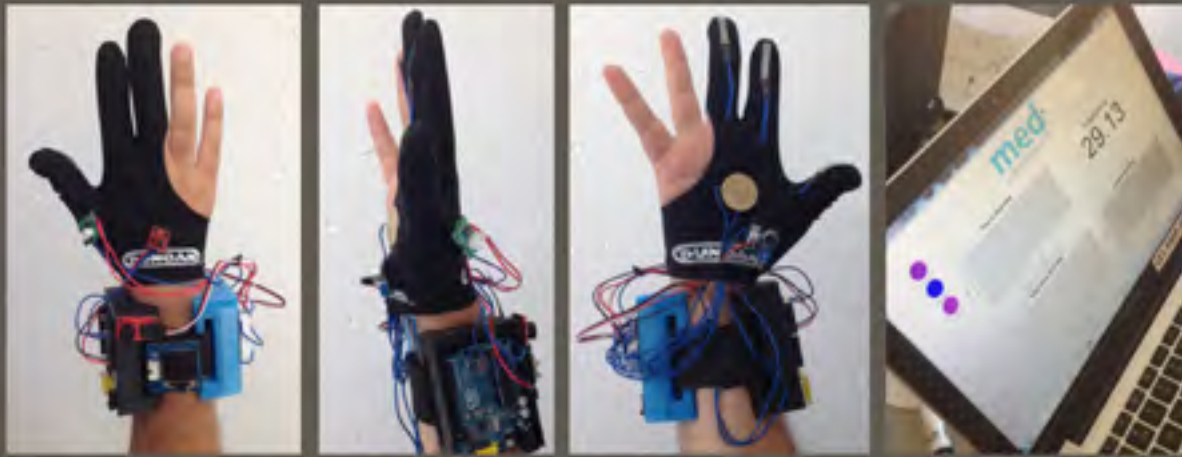
- **Thermometer**
- **Buzzer/Speaker**
- **Electronic Palpation**
- **Galvanic skin conductance**




- **Camera**
- **Heat Infrared Camera**



2nd prototype
August 15 2012



developed at
 SINGULARITY
UNIVERSITY



with
PETER
DIAMANDIS at
SU GSPI 2
CLOSING CEREMONY

the tricorder



meets
the art of medicine



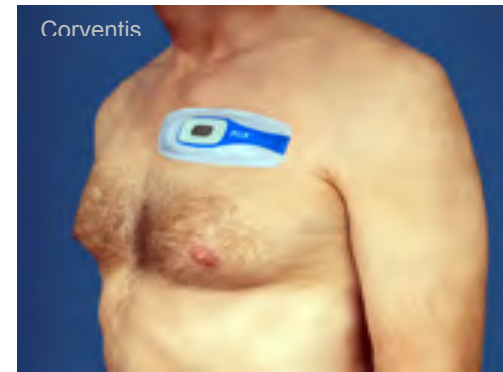
SingularityU.org

VIRTUAL VISITS & TELEMEDICINE

The Digital Check Up

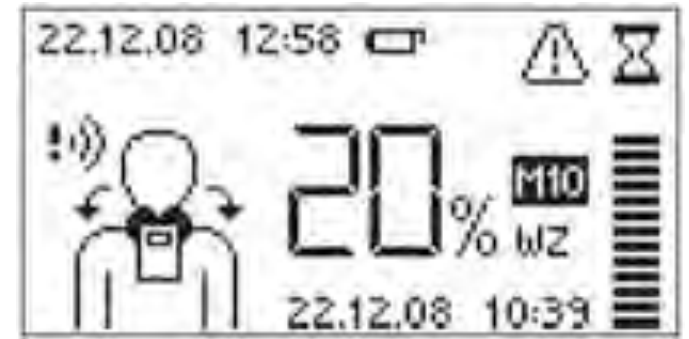


WIRELESS HOME MONITORING

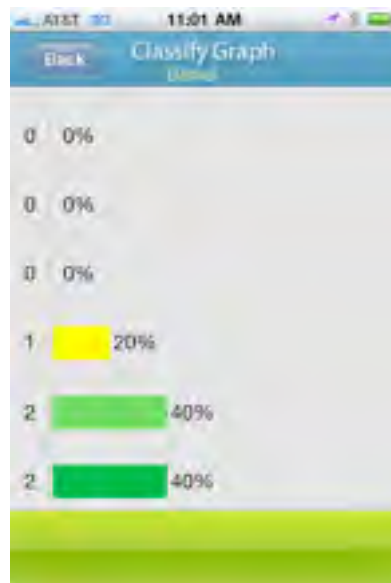


HEALTHWARE

WheezoMeter...



Connected Blood Pressure Cuff

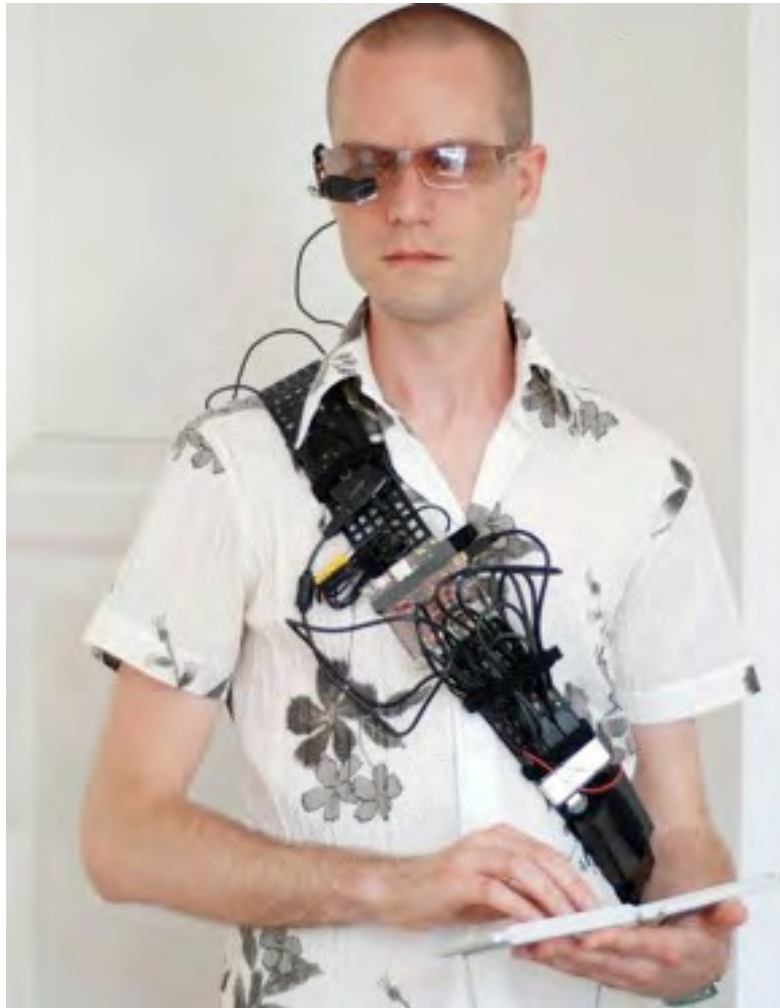


Prescribing Apps...



careticker.com

Wearable Computing / **Body Computing**



Today



Quantitative storytelling



LARK



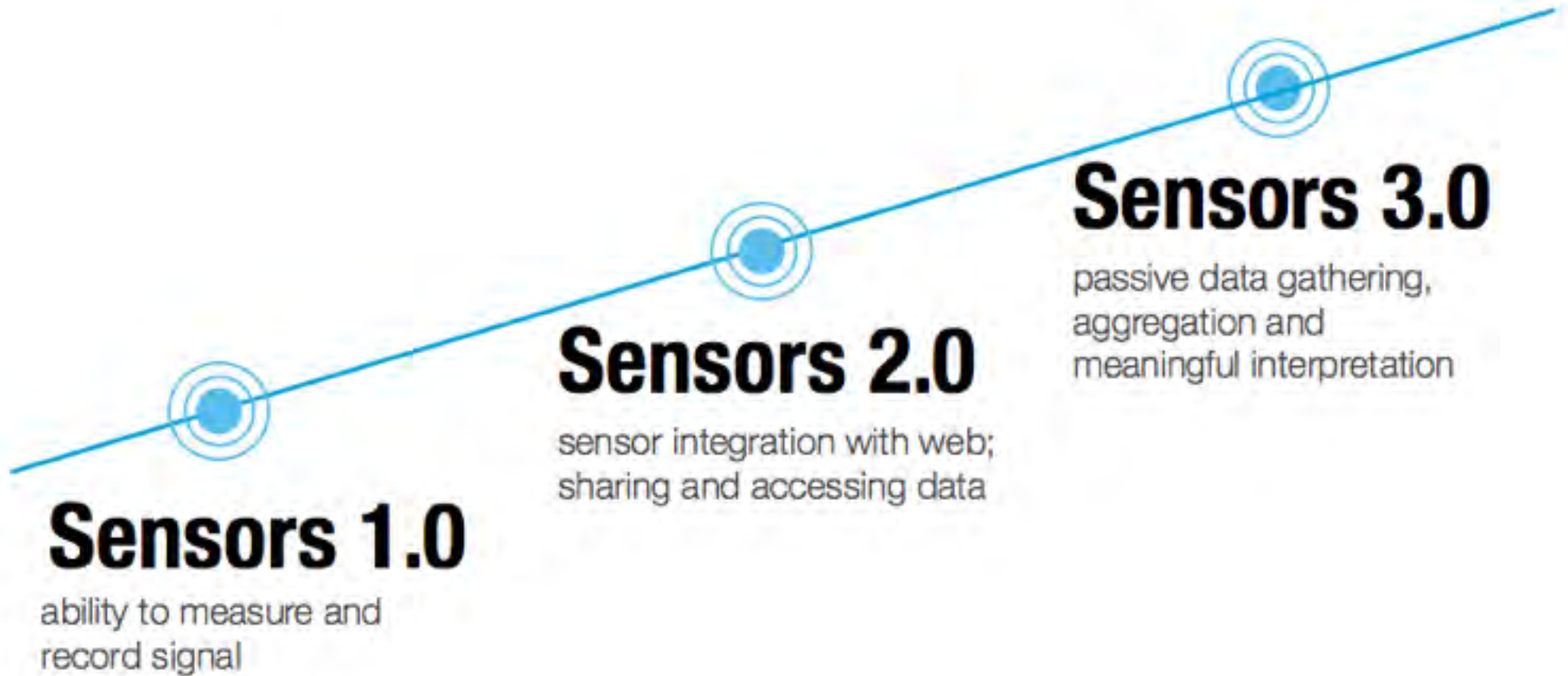
Commercial health sensors





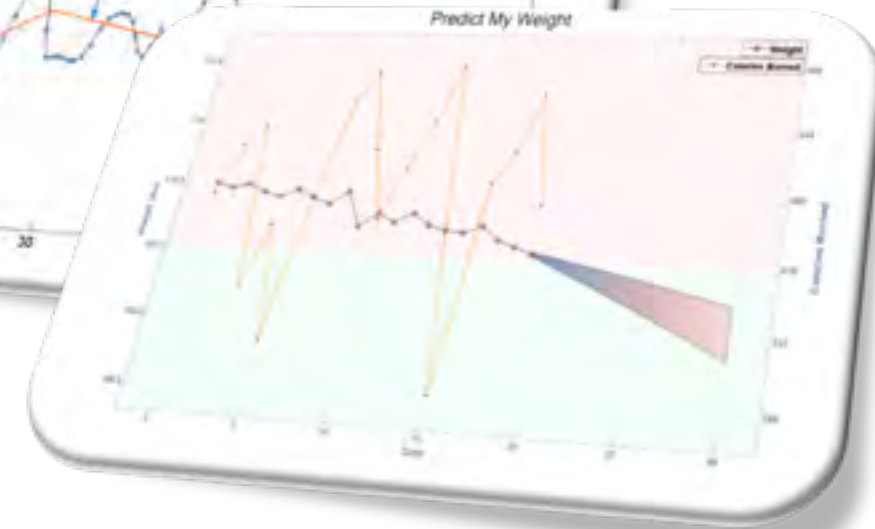
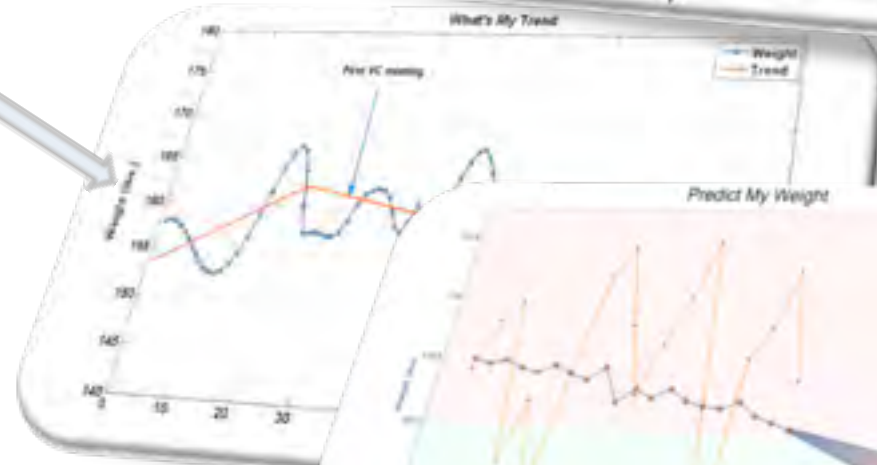
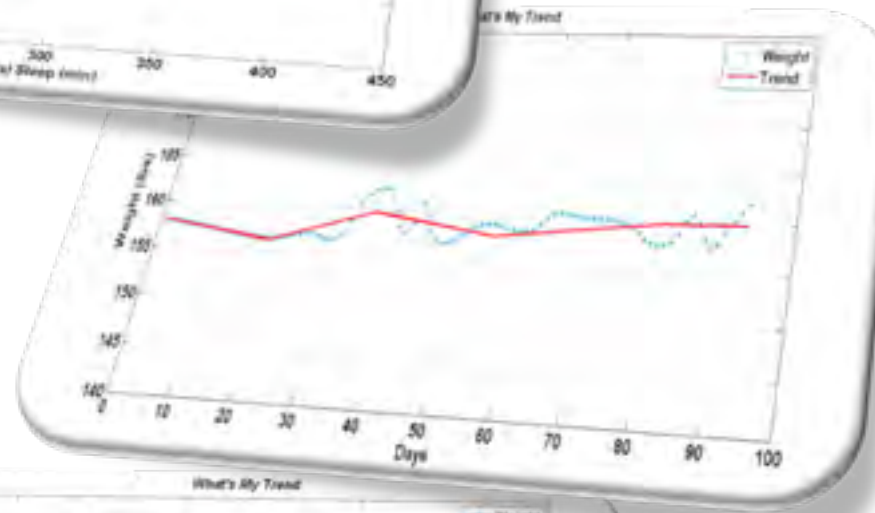
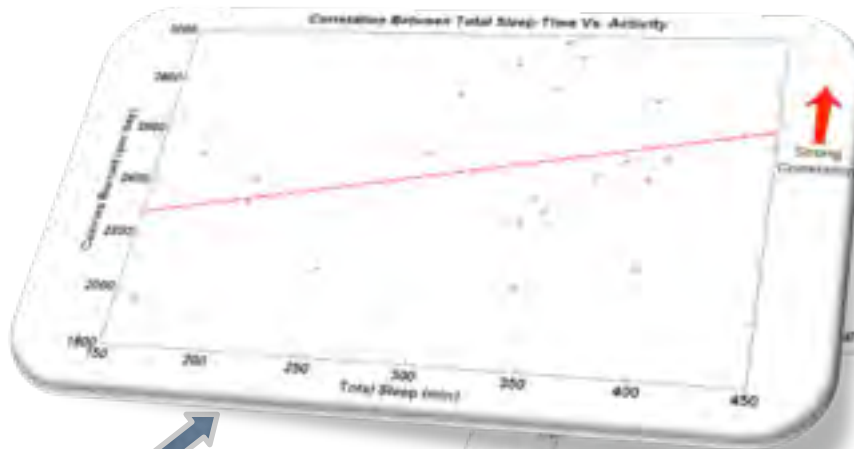
1. [Pocketfinder](#) personal GPS locator
2. [Tagg](#) GPS dog tracker
3. [Fitbit One and Zip](#) physical activity sensors
4. [iPING](#) personal putting coach and app
5. [Wahoo Fitness](#) bluetooth heart rate strap
6. [Scosche Rhythm](#) heart rate monitor armband
7. [Jawbone Up](#) physical activity and sleep sensor
8. [Pear Training](#) heart rate monitor and training app
9. [Adidas MiCoach](#) bluetooth heart rate monitor
10. [Adidas MiCoach Speed Cell](#) activity sensor
11. [Nike+](#) sports sensor
12. [Nike+ Fuelband](#) physical activity sensor
13. [Withings](#) baby monitor
14. [Philips in.Sight](#) wireless baby monitor
15. [IZON](#) Wireless Camera -
16. [Philips in.Sight](#) wireless camera
17. [Lark](#) sleep sensor wristband
18. [Lark Life](#) physical activity and sleep sensor
19. [iBGStar](#) blood glucose sensor
20. [iHealth](#) wireless blood pressure wrist monitor
21. [Withings](#) blood pressure monitor
22. [Withings](#) wireless scale

Sensor Evolution





Smart Integration





drive **On**

VEHICLE DIAGNOSTICS

Let us take care of your vehicle's key operating systems - plus help you save on gas, oil, money, and time. That's the power of OnStar Vehicle Diagnostics.

travel **On** ▶

live **On** ▶

always **On** ▶

drive **On** ▶

send **On** ▶

talk **On** ▶

log On

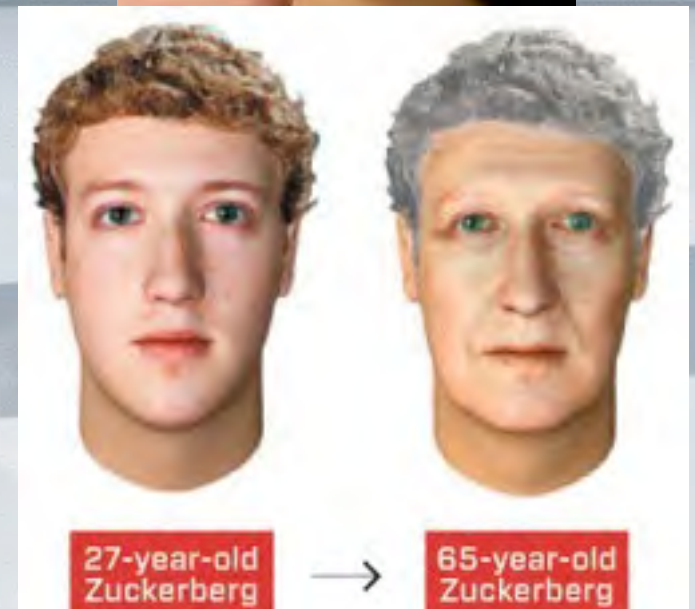
ONSTAR MYLINK MOBILE APP
Connect with your vehicle. Wherever it is. Whenever you want. [Learn More](#)

WATCH VIDEO

on OnStar
Updated
Tank level
75%
Lifetime



Augmented Reality for Behavior Change



DESIGN THINKING / Re-IMAGINE LAB REPORTS

Before and after: Wired magazine redesigns the lab report

The basic setup

The standard blood workup takes more than 20 measurements and can go on for more than four pages. All sorts of things can turn up in the report, the challenge for physician and patient alike is to find the signal within the noise.

Make it colorful

The quality of color printers, email, and PDF's means there's no excuse not to use one of the most effective tools in information design. We added a familiar green-yellow-red palette to make it easier to identify what needs immediate attention.

Make it relevant

Information is useless without explanation and a call to action. So we grouped this patient's results with the relevant health risks and offered guidance about what the doctor might want to happen next.

Make it clear

Doctors presumably know what high or low numbers might mean, but there's no reason not to explain the data with parallel interpretations for all results above and below "normal." Are your numbers a little low or a lot low? We explain.

Make it easy

Listing various "reference ranges" is the right of the page, except for the results, forces the eye to scan back and forth as you evaluate the numbers. We add charts that depict clearly and succinctly where you fit along the spectrum.

Make it simple

The point is to get the first of four done pages. The original lists dozens of measurements, particularly too many for even a doctor to comprehend. We summarize the most essential tests, include the most relevant numbers, and add on your eye at the top of the page.

Your Test Results

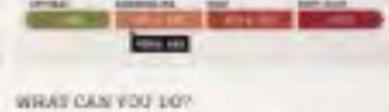
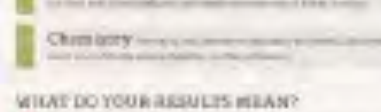
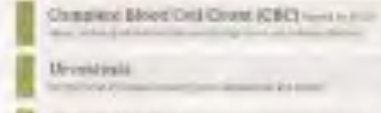
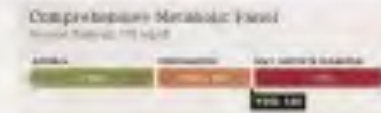
What's in a glass?

- Normal** (green)
- Low** (yellow)
- High** (red)

Quick key

- Normal** (green)
- Low** (yellow)
- High** (red)

RESULTS



WHAT DO YOUR RESULTS MEAN?

Normal (green): The test results are within the normal range of values for your age and sex. This is a good sign.

Low (yellow): The test results are below the normal range of values for your age and sex. This may indicate a health problem.

High (red): The test results are above the normal range of values for your age and sex. This may indicate a health problem.

WHAT CAN YOU DO?

Normal (green): If you have any symptoms, talk to your doctor about them. If you don't have any symptoms, you're probably fine.

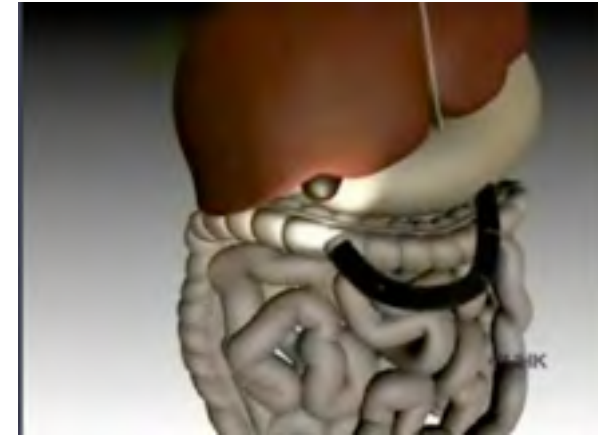
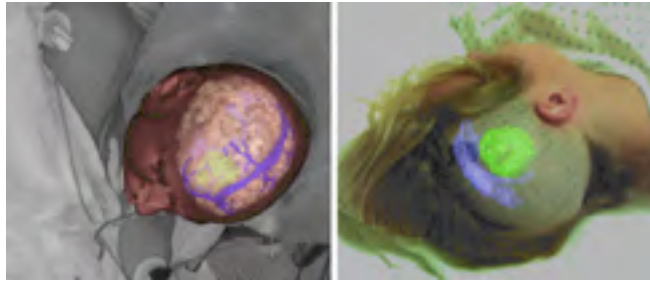
Low (yellow): If you have any symptoms, talk to your doctor about them. If you don't have any symptoms, you may need to eat a healthier diet or exercise more.

High (red): If you have any symptoms, talk to your doctor about them. If you don't have any symptoms, you may need to stop smoking or drinking alcohol.

ROBOTICS / ENABLING THE SURGEON



ROBOTIC SURGERY



- Augmented Reality
- Decision Support
- Remote Mentoring
- Scarless surgery

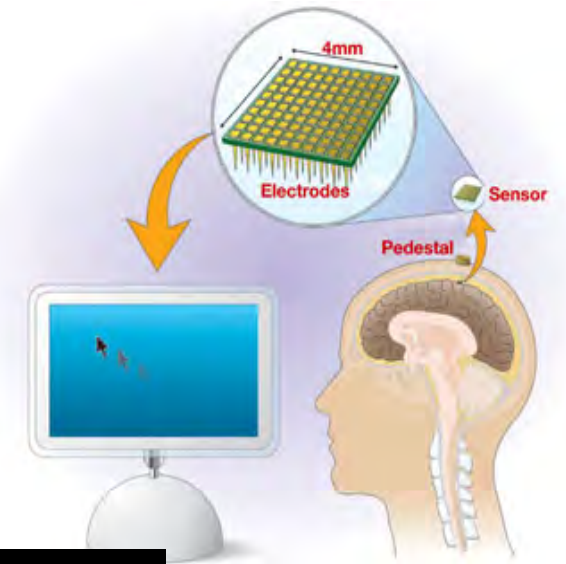


Intuitive Surgical

BRAIN-COMPUTER INTERFACE (B.C.I.)



Braingate2.org



- Chip on Motor Cortex
- Clinical trials underway in quadraplegics



Consumer BCI Devices



INTEGRATION

Brain to Bionics



LUKE Arm



Dean Kamen



Daniel Kraft MD



“Exoskeletons Will Be the Eyeglasses of the 21st Century”

Discover Magazine January 2012

“Exoskeletons Will Replace the Wheelchair”

Bigthink.com - January 2012

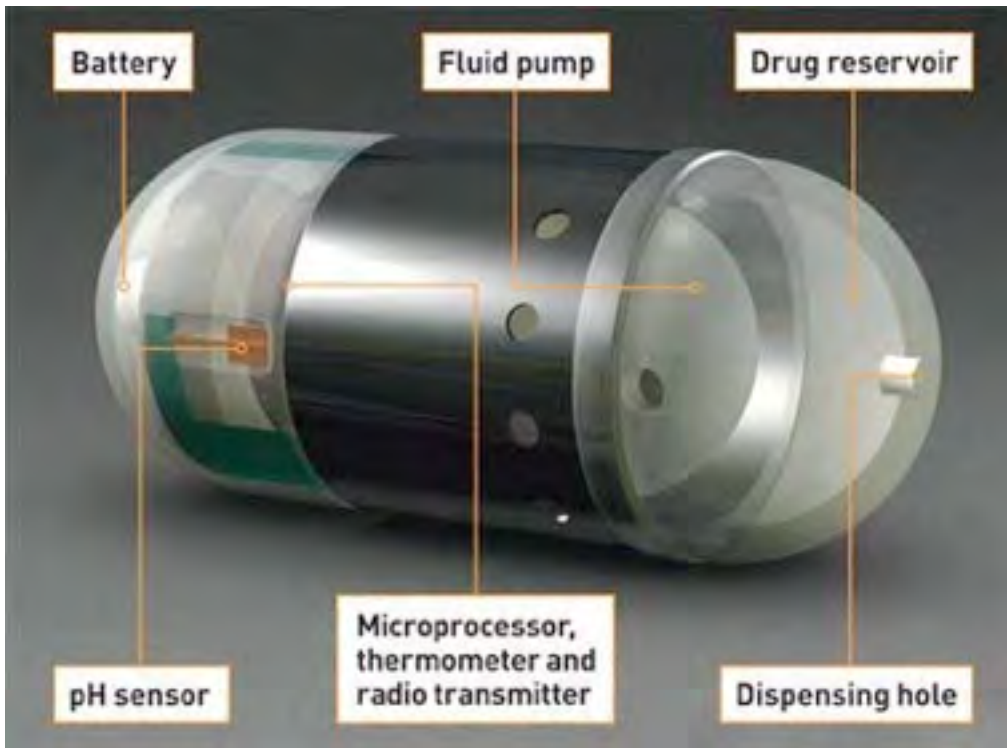


Exponentially
Faster
Smaller
Cheaper
Better



FANTASTIC VOYAGE

iPill... Diagnosis and Rx



GENERAL



SUSPECTED BARRETT'S

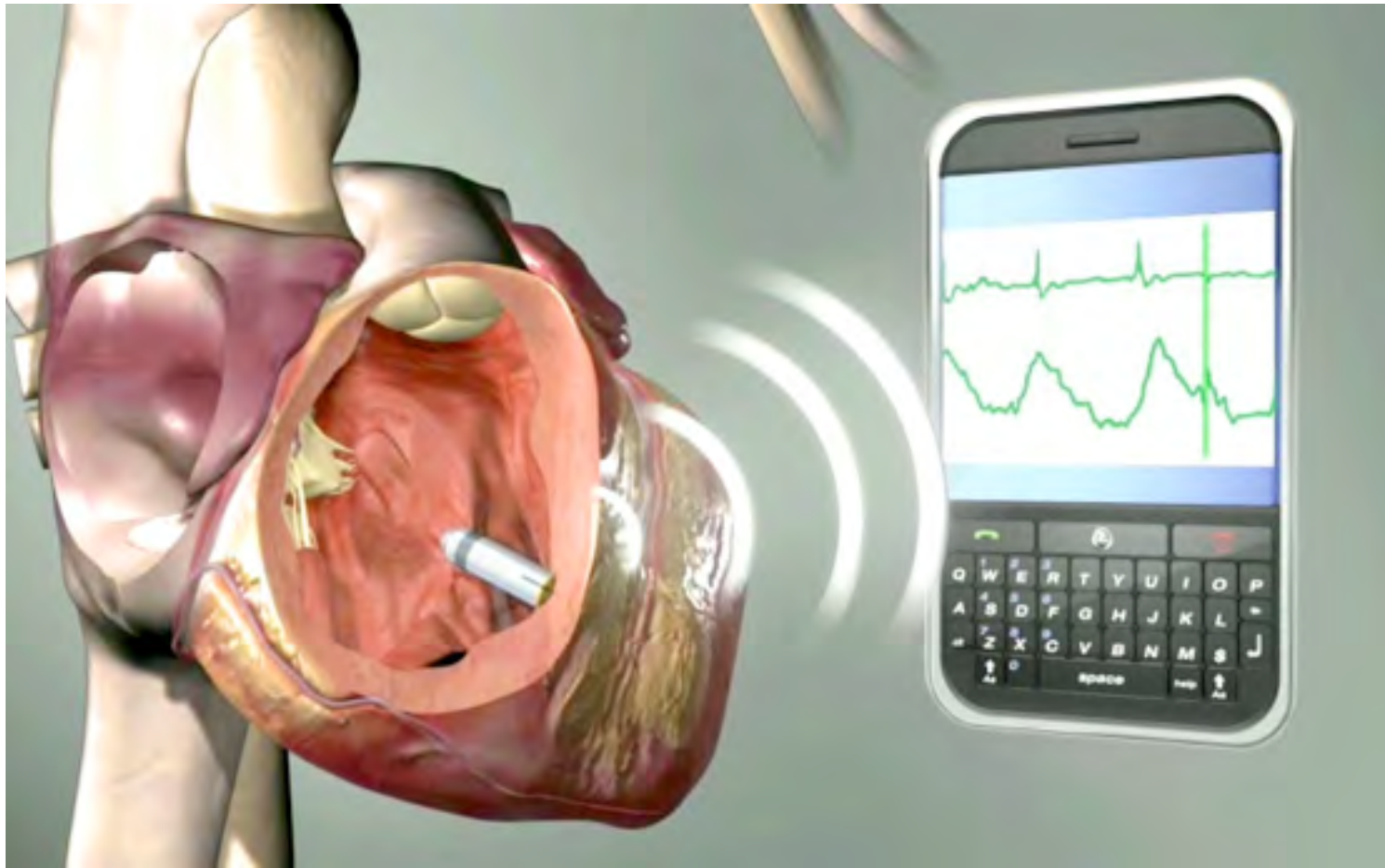


ESOPHAGITIS

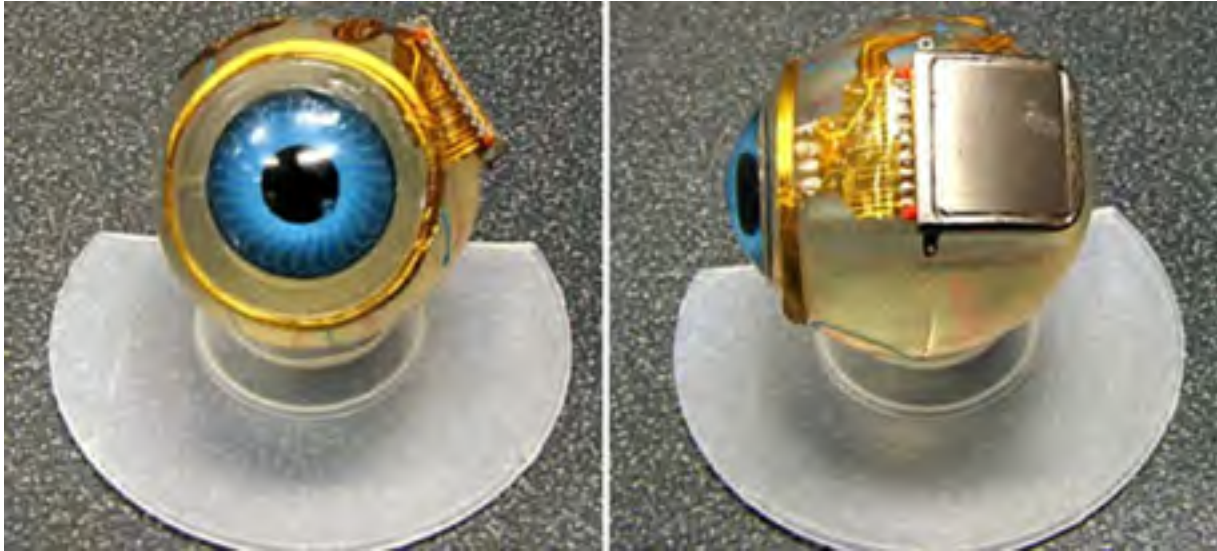


VARICES



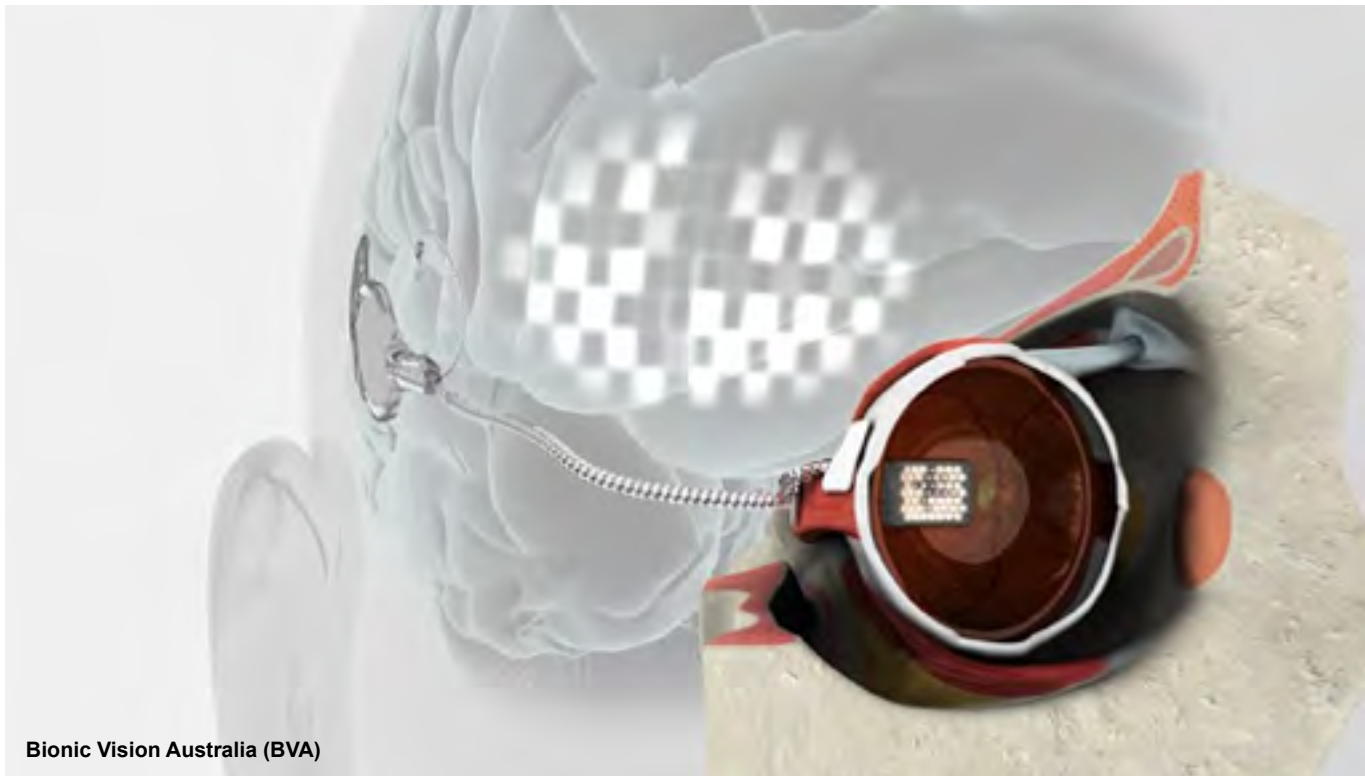


BCI: Retinal Implants



'I've dreamed in colour for the first time in 20 years': Blind British man can see again after first successful implant of 'bionic' eye microchips

May 2012



Google Glass to stream Internet straight to eyeballs...



Behind the Google Goggles, Virtual Reality

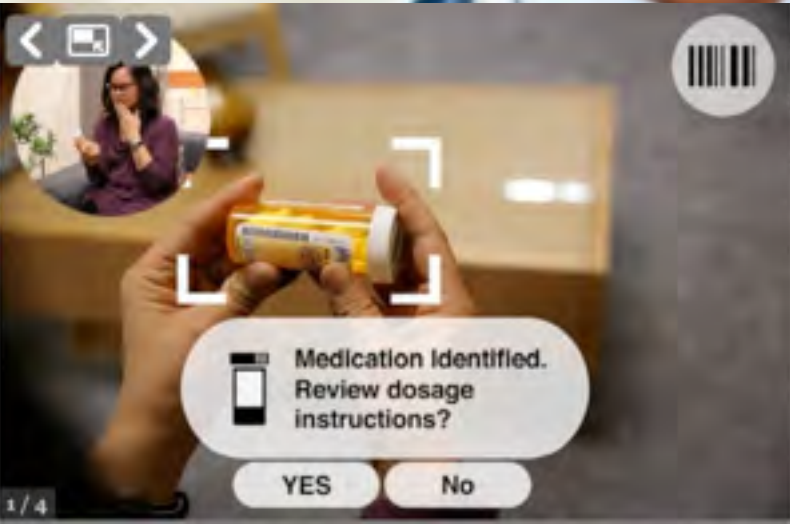
By [NICK BILTON](#)

Published: February 22, 2012



Google Glass Healthcare Applications

Patient care through glass





DESIGN THINKING
THINK DIFFERENT

Lessons from AVIATION applied to HEALTHCARE



Cockpits: Analog to Digital



**JOHNS HOPKINS
COLLABORATES WITH
LOCKHEED MARTIN TO
BUILD NEXT-GENERATION
INTENSIVE CARE UNIT**

Systems Integration, Virtual Simulation
to Guide Study of Complex Health Care
Setting







CheckLists



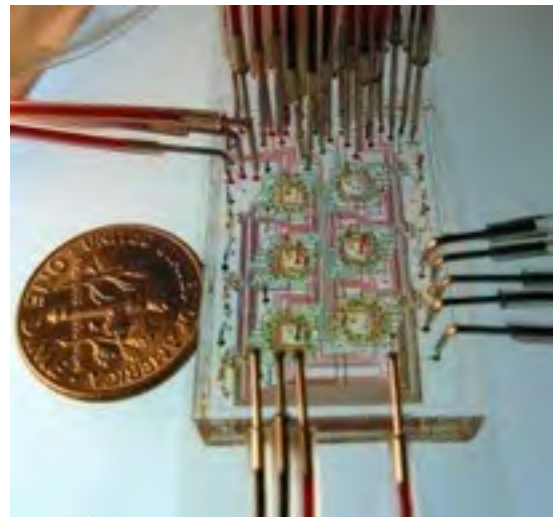
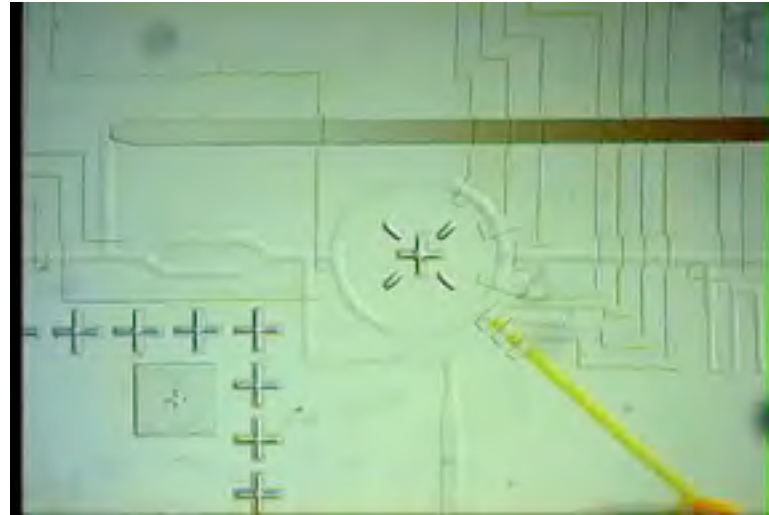
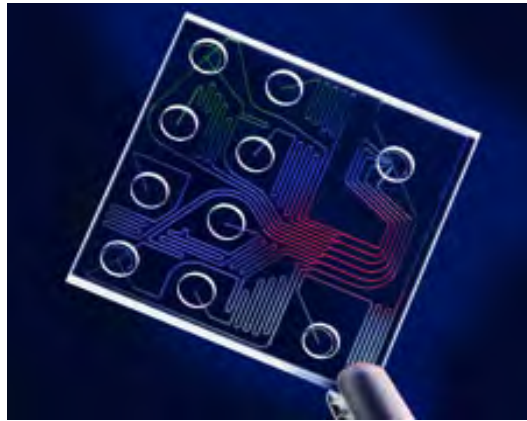
Simulation



Air Traffic Control

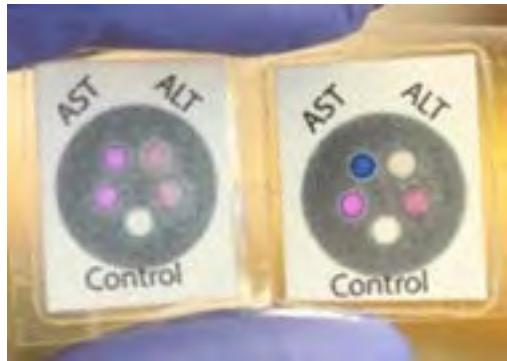
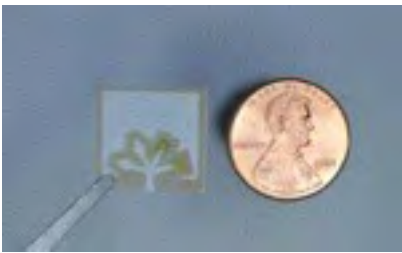


LAB ON A CHIP



Quake lab, Stanford





George Whitesides Lab, Harvard

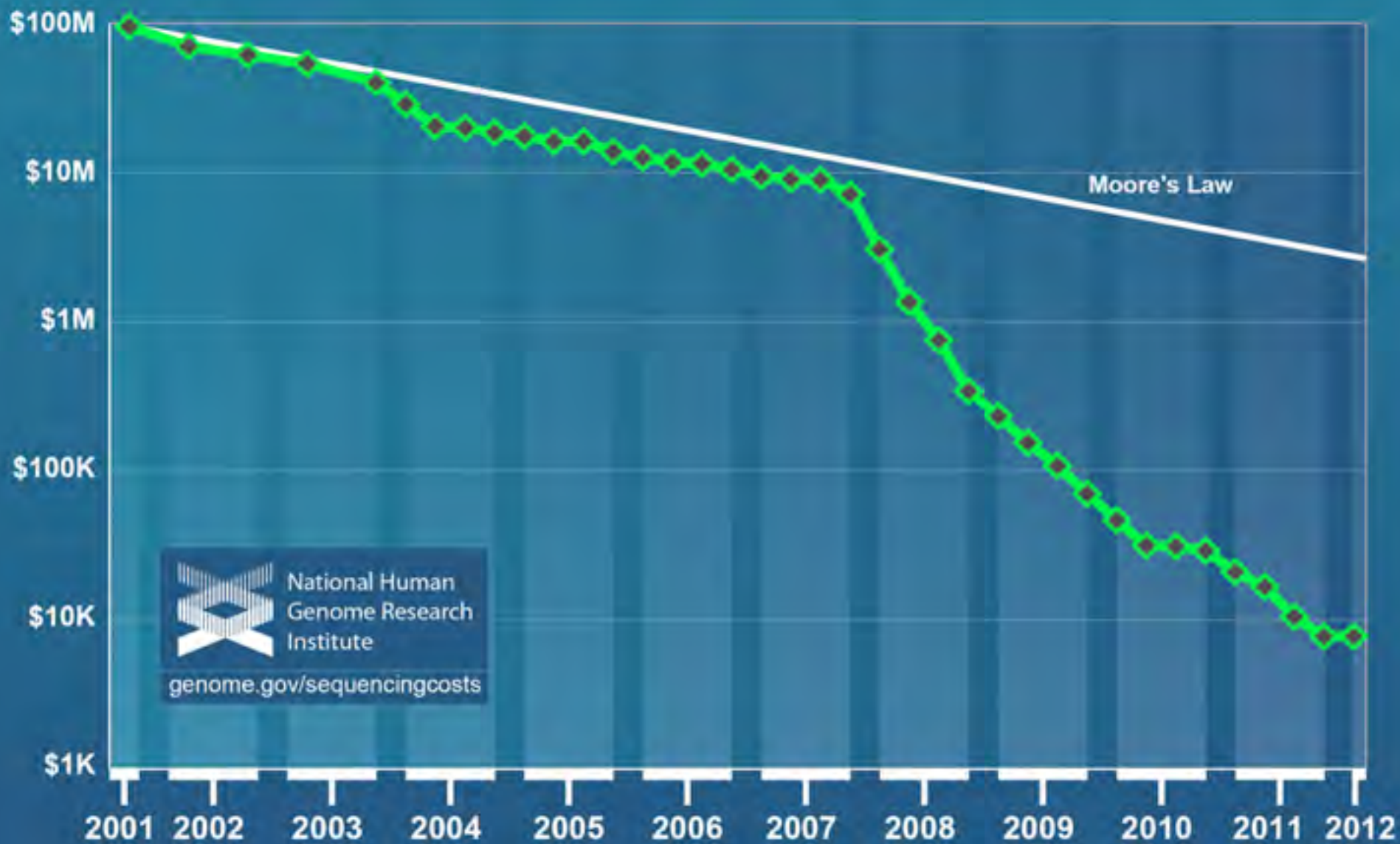
Digital Checkup from Anywhere...





Exponentially
Faster
Smaller
Cheaper
Better

Cost per Genome



Human Whole Genome Sequencing & Functional Interpretation



Knome delivers your data on a secure hard drive. Just click to access raw reads, queryable annotated genomes, candidate shortlists, and powerful software tools.



includes human whole genome sequencing (30X), annotation, and comparative analysis for **only \$4,998 per genome** (minimum 10 genomes)

 Lock-In Pricing

While quantities last.

Egypt Divided / Pot's Big Moment / Best of 2012 Movie, Music, Books, More

TIME

Want to Know My Future?



A baby sitting in a diaper is the central focus, surrounded by labels for various diseases and conditions: Alzheimer's, Diabetes, Cancer, Hemochromatosis, Cystic Fibrosis, Tay-Sachs disease, Huntington's disease, Breast cancer, Colon cancer, Parkinson's, Glaucoma, Obesity, Marfanoid habitus, Prandial glucose, and Pharyngitis.

New genetic tests can point to risks — but not always a cure

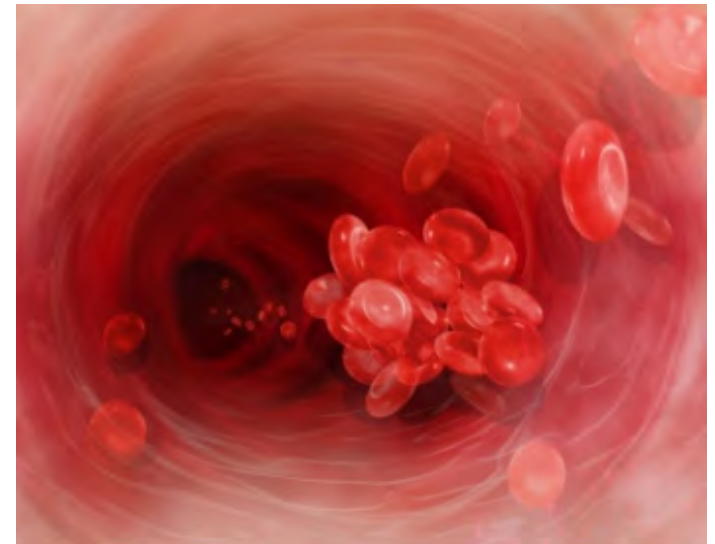
BY BONNIE ROCHMAN

\$100 Genome...by 2015 ?



Your Genetic Data

Who	What It Means
	Substantially increased warfarin sensitivity. May require greatly decreased warfarin dose.
	Increased warfarin sensitivity. May require decreased warfarin dose.
Greg Mendel (Dad)	Slightly increased warfarin sensitivity. May require decreased warfarin dose.
Daniel Kraft Lilly Mendel (Mom)	Typical warfarin sensitivity.



Show genotypes for:

SNP	Genotype	Combination	Result
rs1799853	CC	CYP2C9 *1/*1, VKORC1 -1639/3673 GG	Typical warfarin sensitivity.
rs1057910	AA		
rs9923231	CC		



- P4 Medicine**
- Predictive**
- Preventive**
- Personalized**
- Participatory**

Participatory:

The Engaged Empowered Patient & Community



patientslikeme®

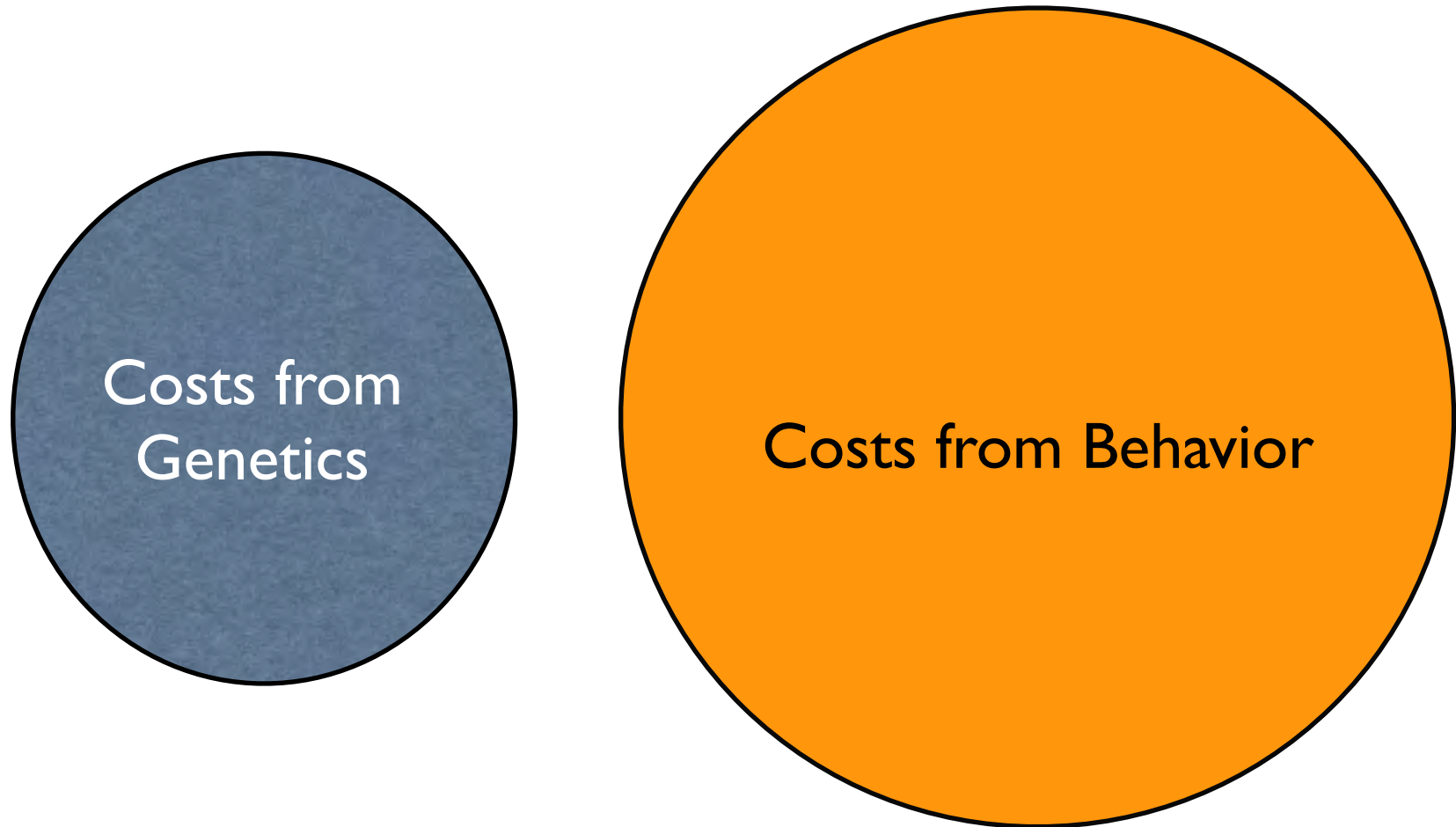


Inspire together we're better™



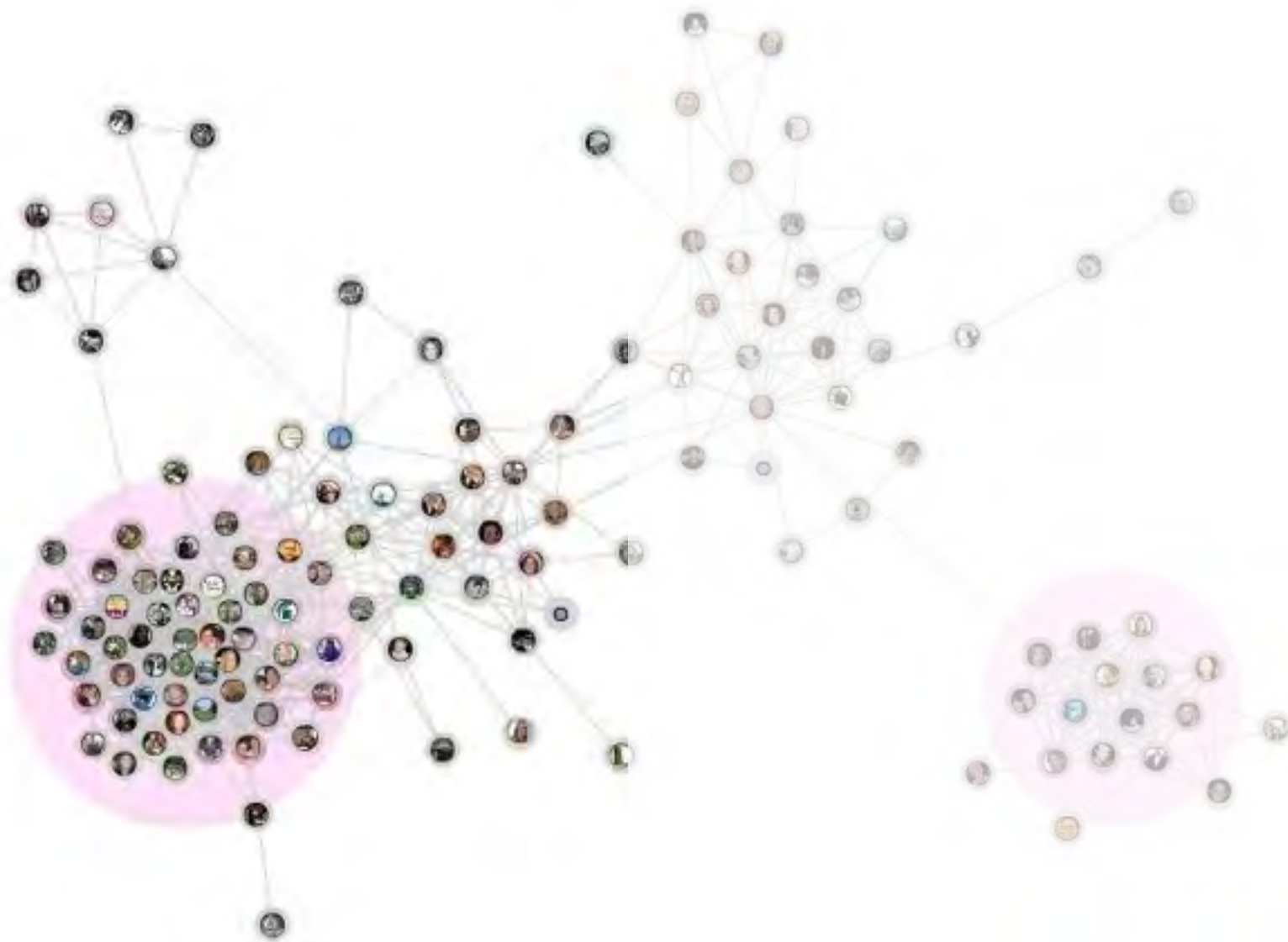
US Healthcare Costs

Are 2.4 Trillion Annually



The Social Graph

The Hidden Network





Exponentially...

Faster

Smarter

Smaller

Cheaper

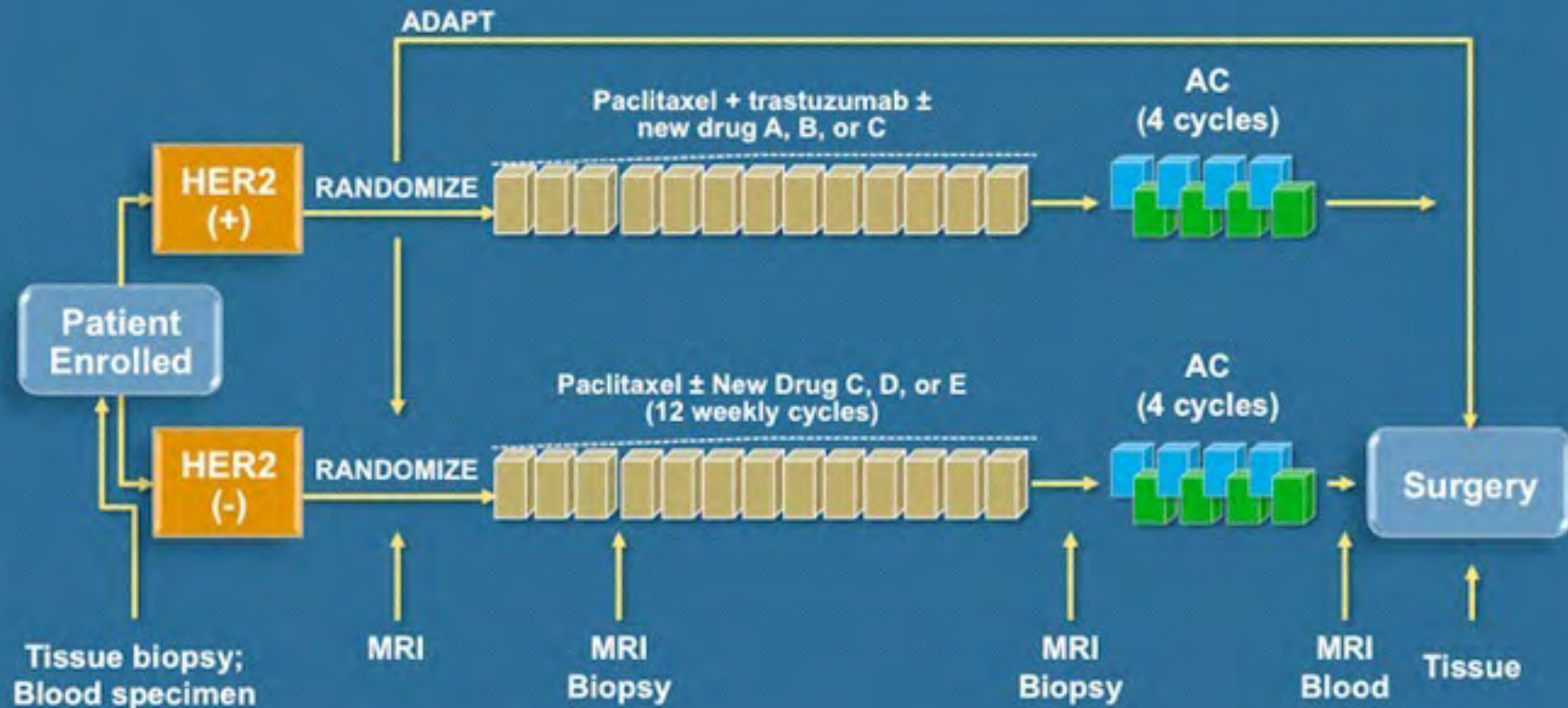
Better



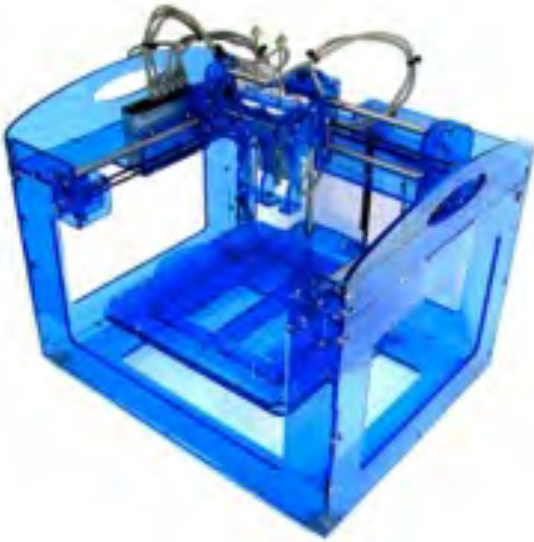
Adaptive Clinical Trials Design

Faster, Cheaper, Smarter...

I-SPY 2: An Adaptive Breast Cancer Trial Design in the Setting of Neoadjuvant Chemotherapy

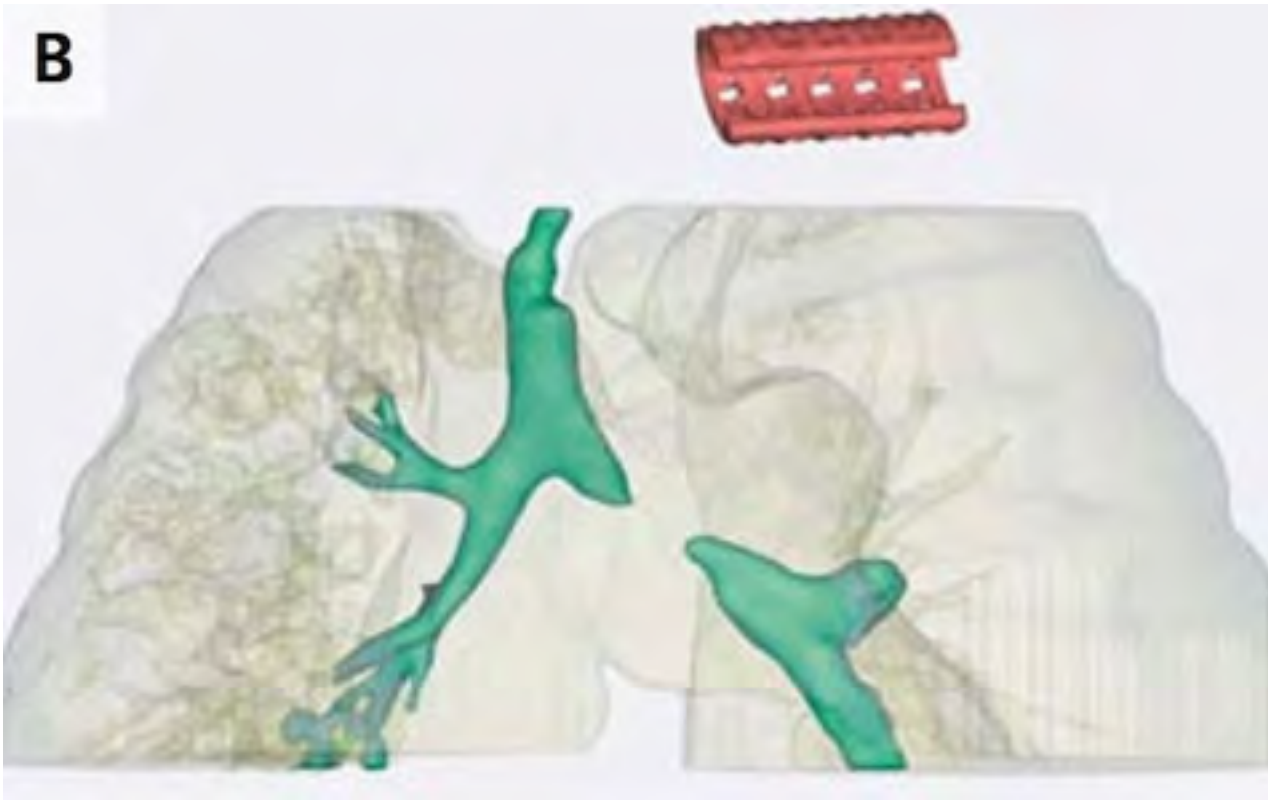


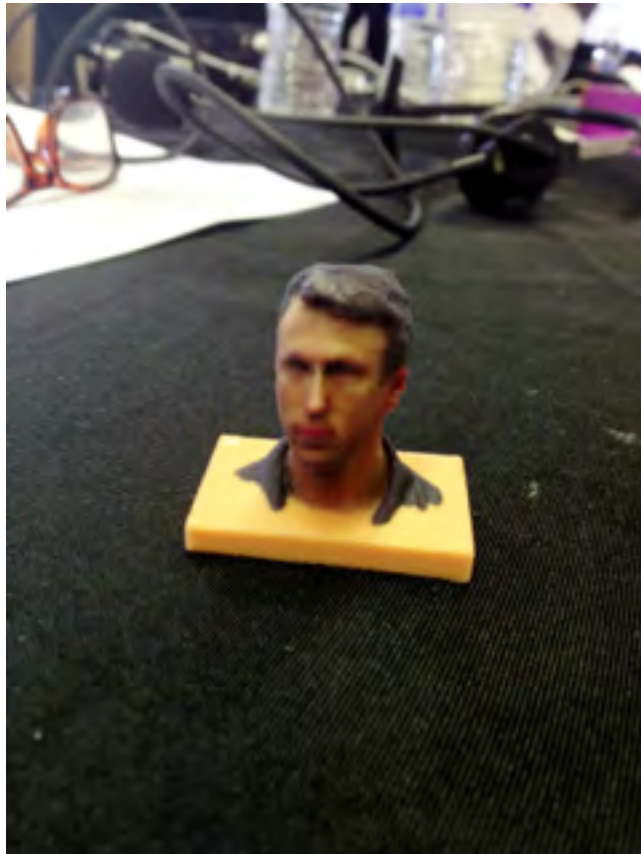
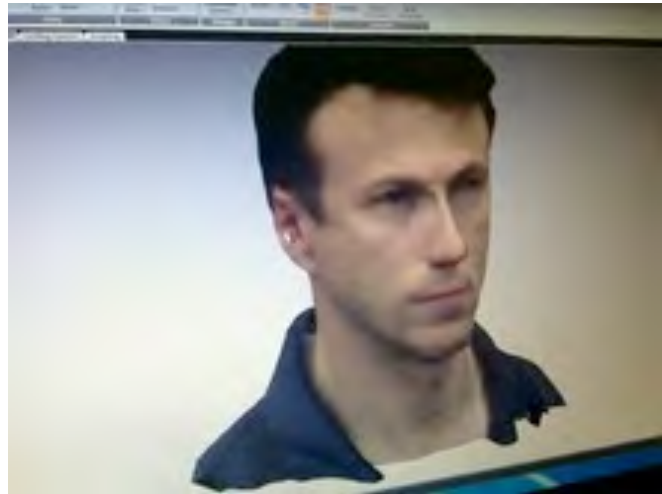
3D Printing / Digital Fabrication



3D Printed Patient Specific Prosthetics



B**C****D**



How a 3D printer gave a man his face - and his life - back

Richard Gray April 01, 2013



Eric Moger has a partial prosthetic face after suffering from face cancer. Photo: Supplied: Geoff Pugh

3D printed ear binds biology with electronics

PRINCETON (US) — Using 3D printing tools, scientists have created a functional ear that can “hear” radio frequencies far beyond the range of normal human capability.

86

f 182

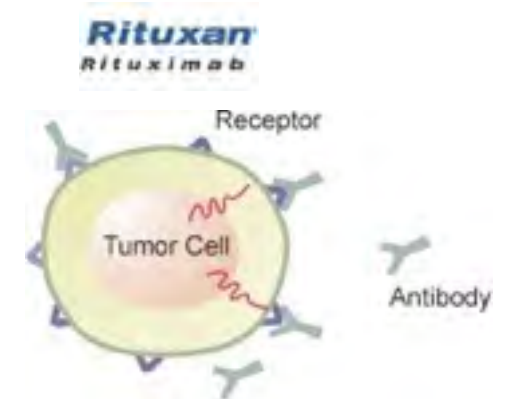
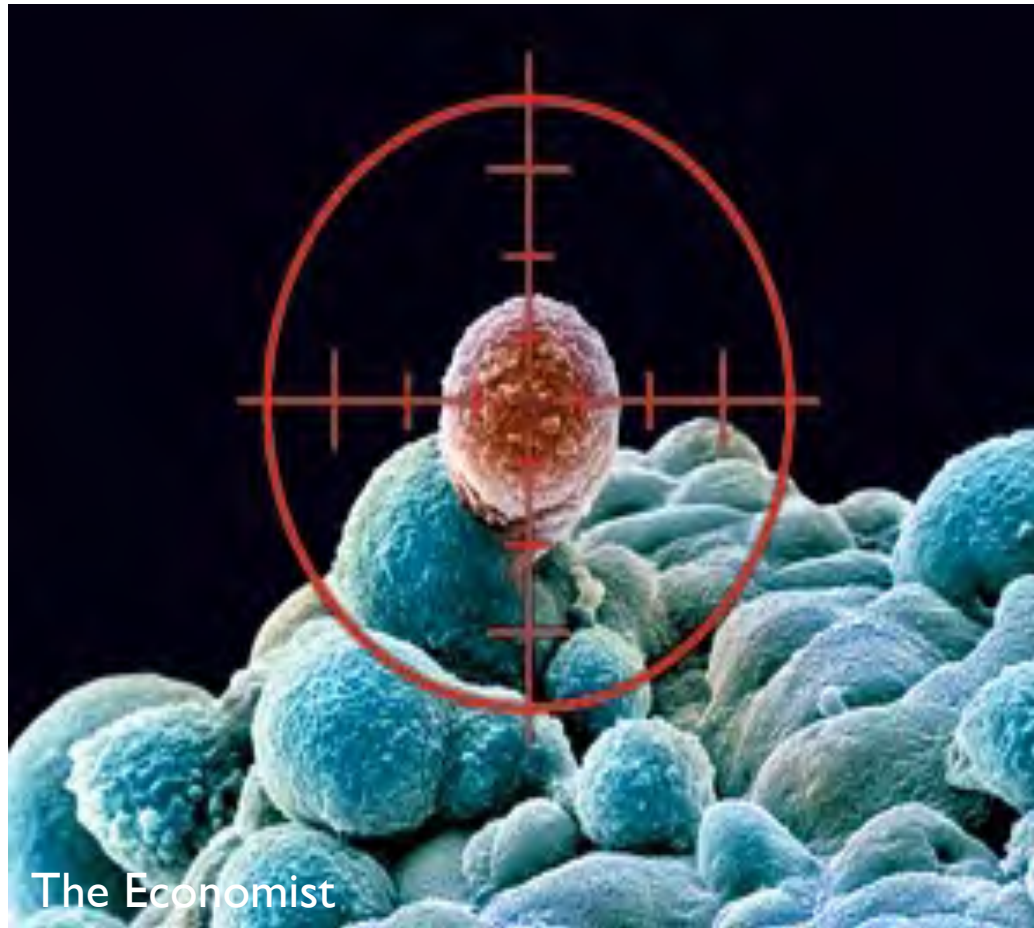
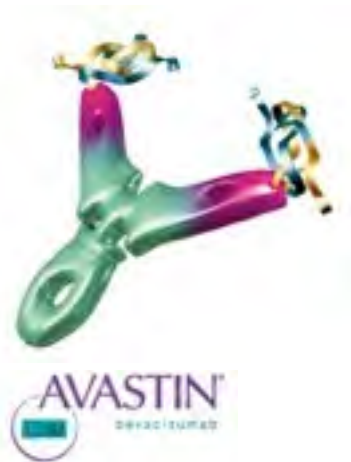
Tweet

f Like

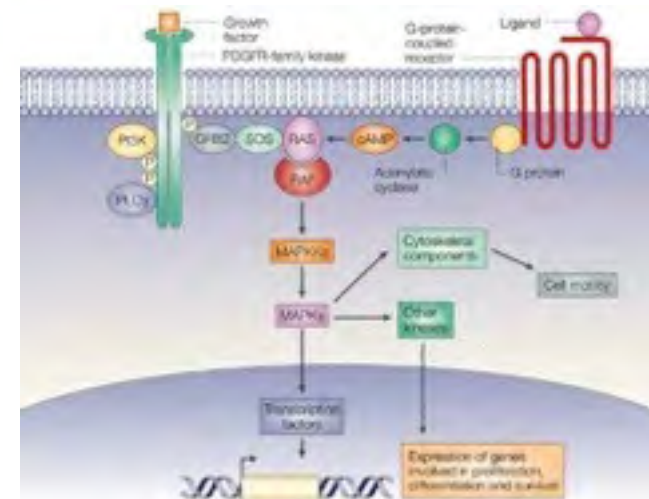
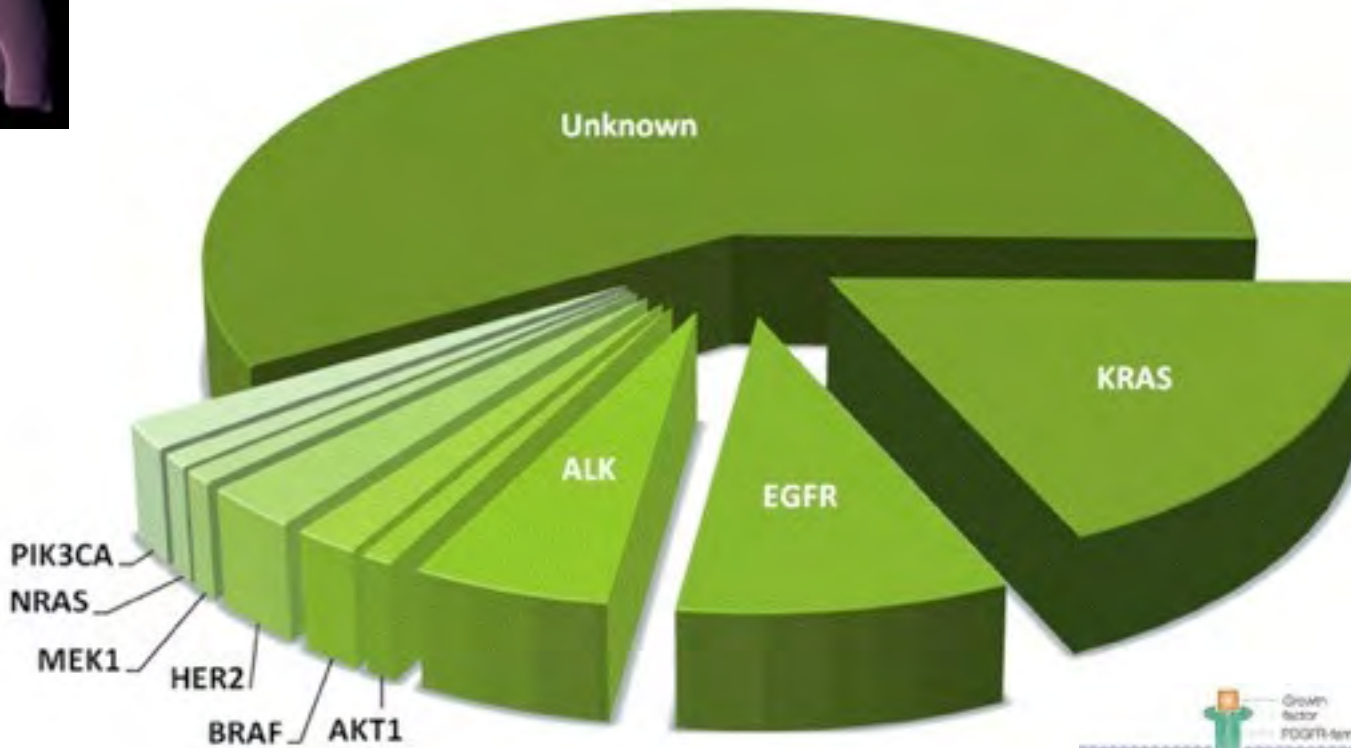


Princeton scientists used 3D printing to create a “bionic ear” made up of a coil antenna and cartilage, demonstrating an efficient method of merging electronics with tissue. (Credit: Frank Wojciechowski)

TARGETED MOLECULAR & GENETIC THERAPY

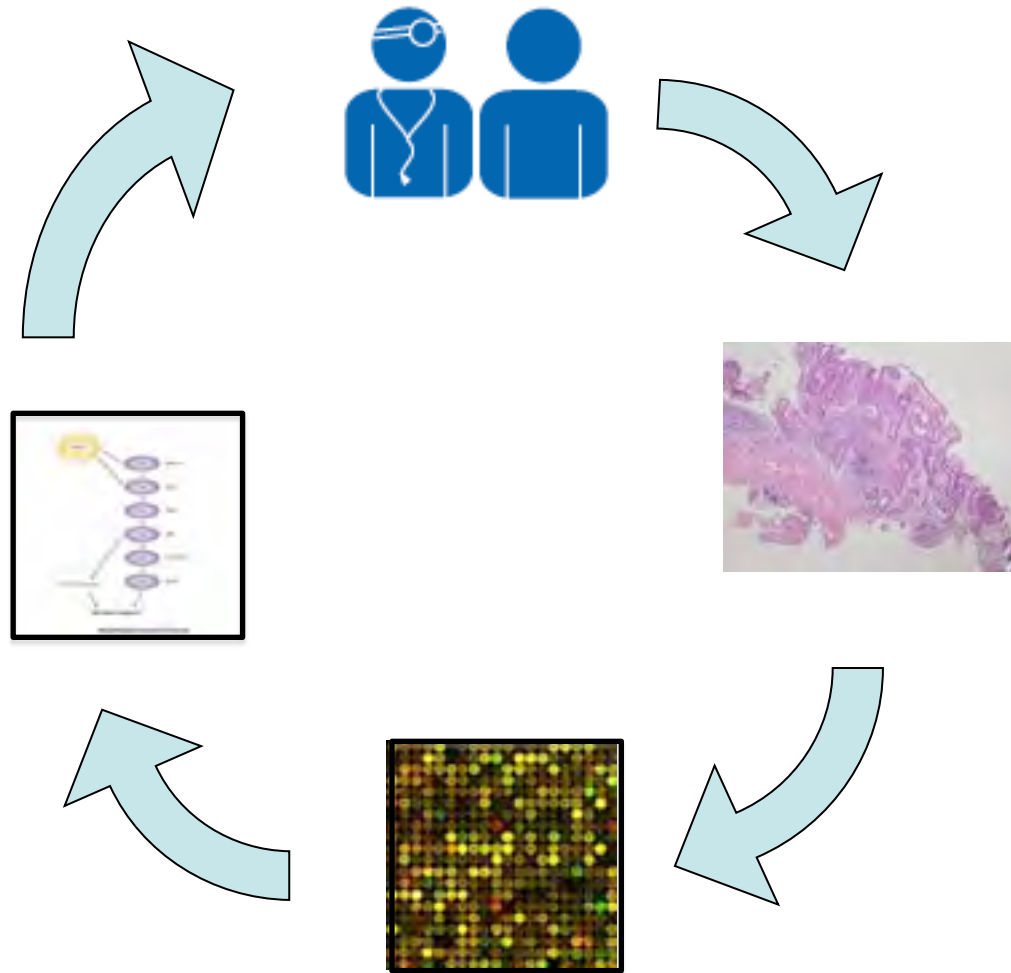


Lung Cancer = 1000s of sub types



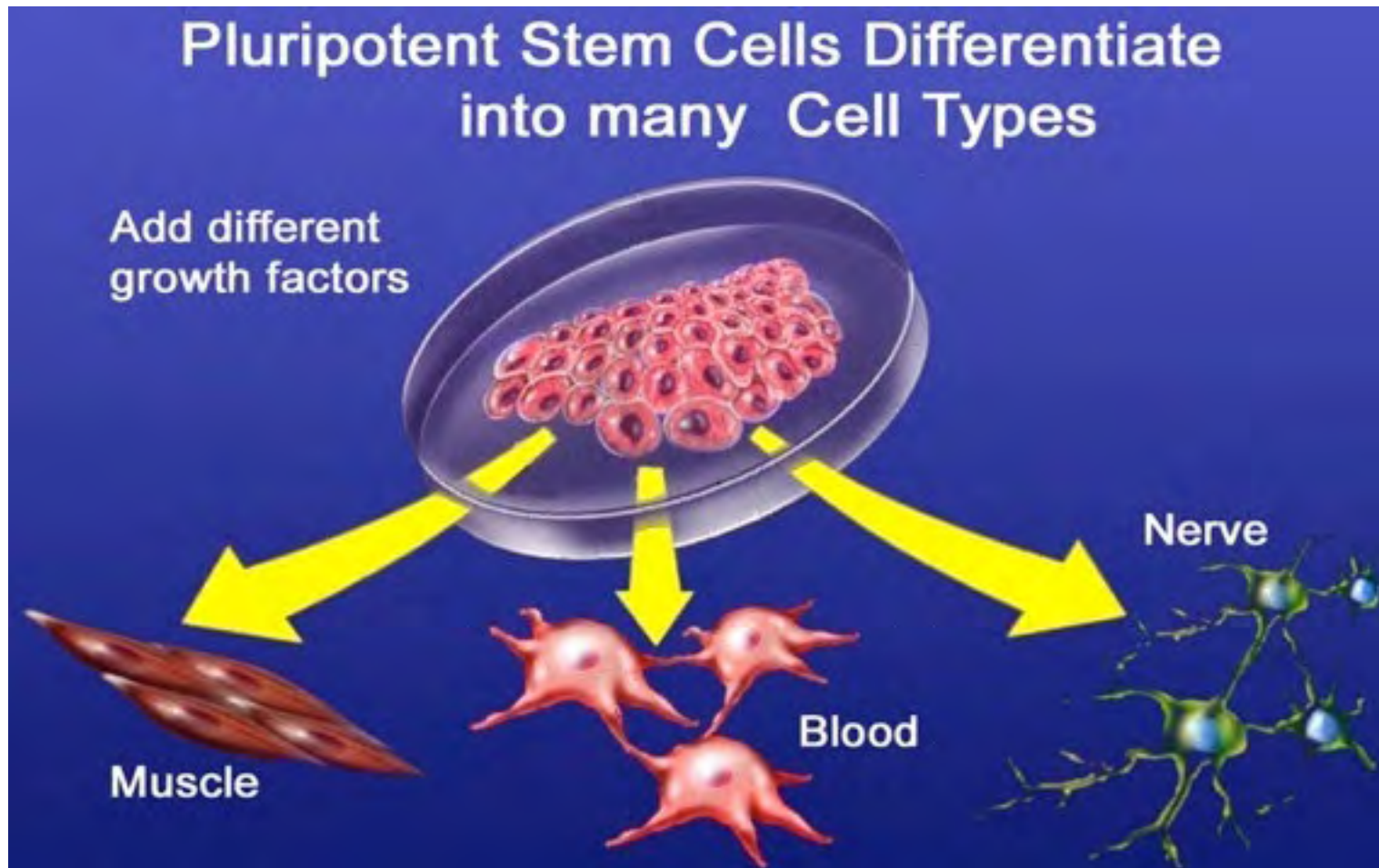
Cbraf.jpg courtesy of Lung Cancer Foundation of America

PERSONALIZED ONCOLOGY



REGENERATIVE MEDICINE

Repair, Replace & Regenerate
Aged, Diseased & Damaged Tissues



INDUCED PLURIPOTENT STEM CELLS (iPS)

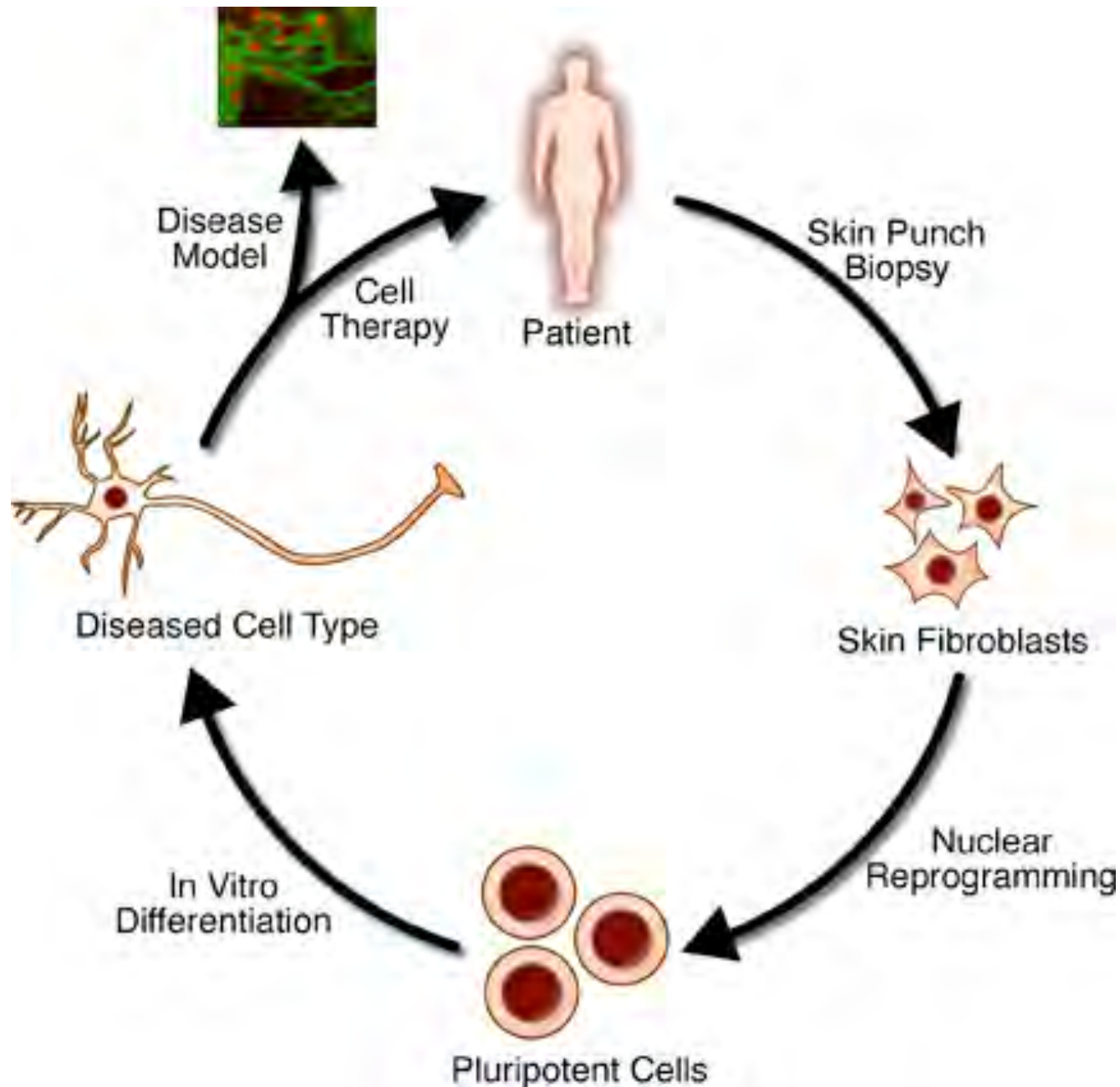


Figure: Kit Rudolfo
StemBook.org

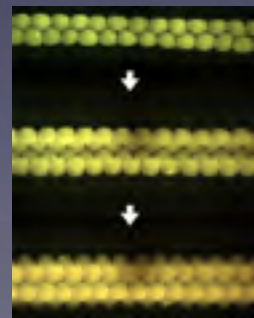
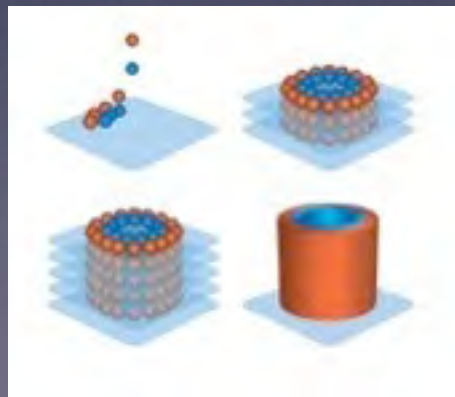
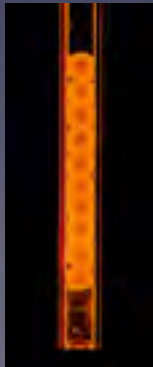
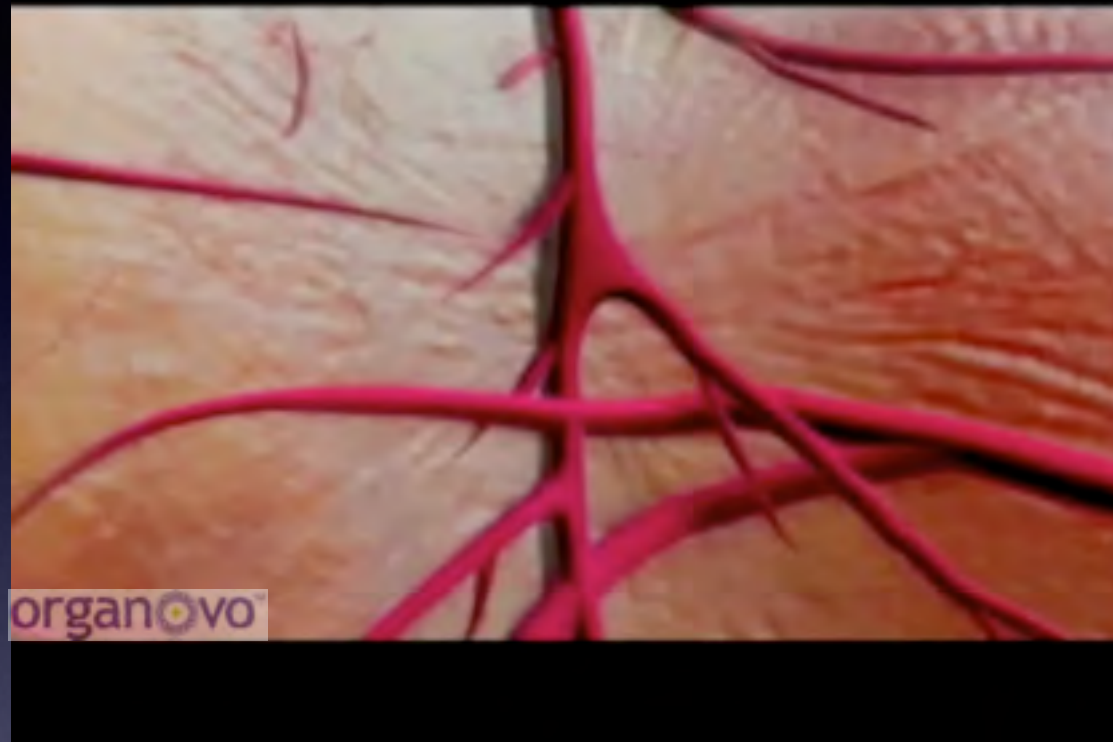
Tissue Engineering: First Synthetic Trachea 2011



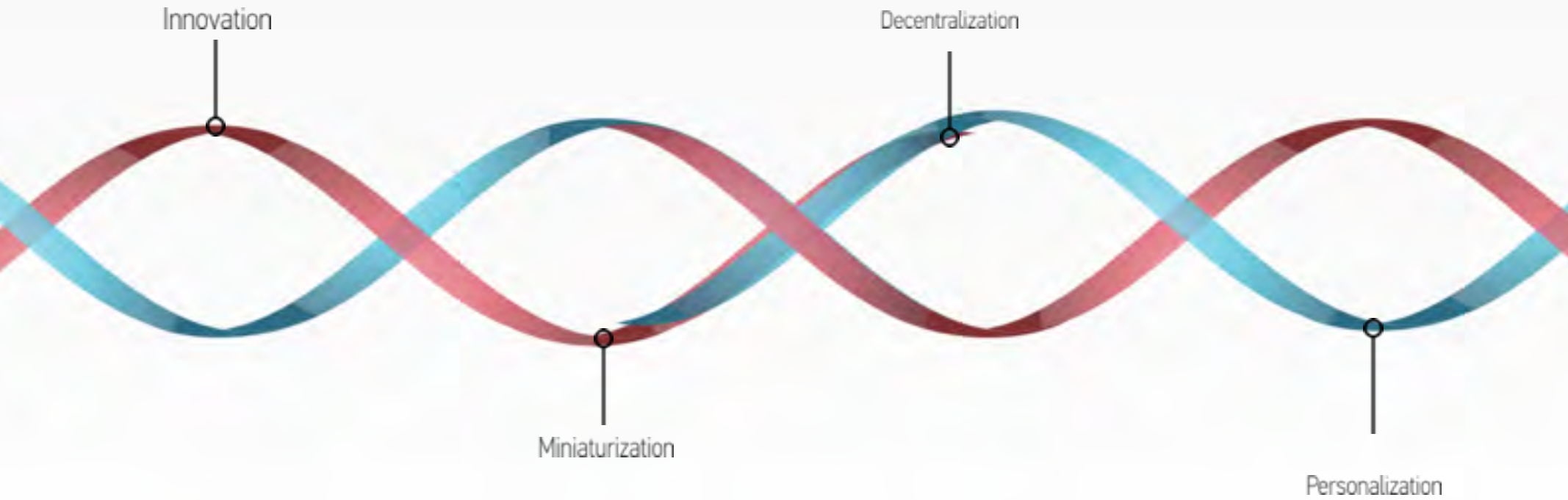


BioFAS 4500
EXCITATOR OF BIOLOGICAL PREPARATIONS

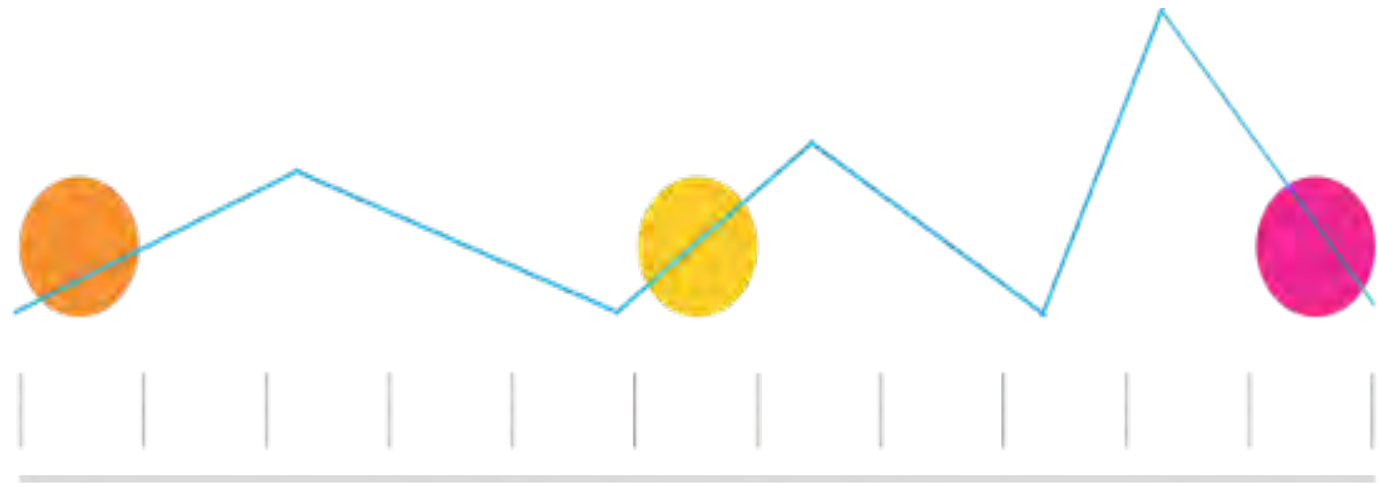
3D Organ Printing



Exponential Trends

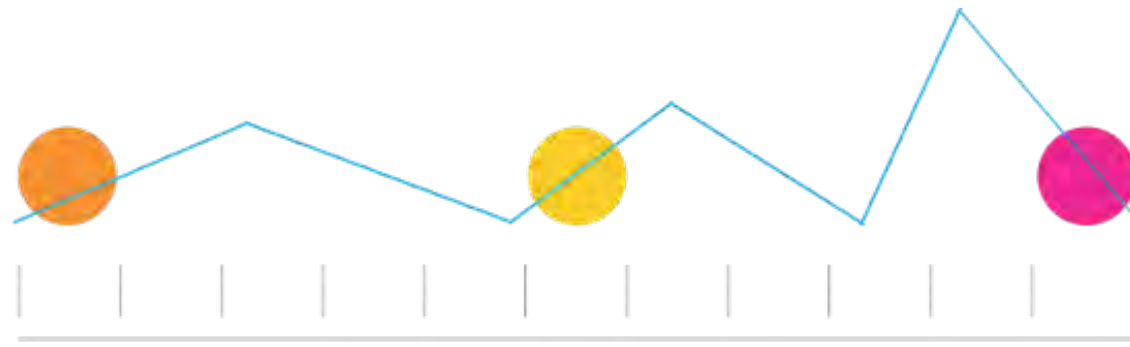


PAST: HEALTH DATA

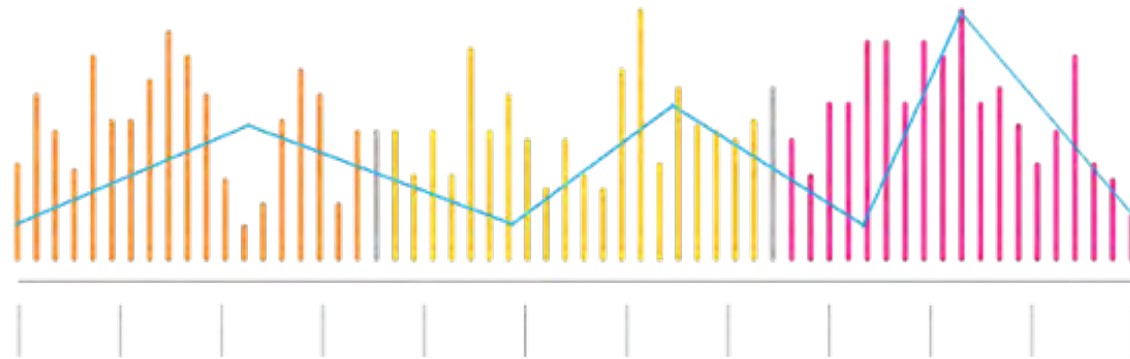


Patient care, measurements are mostly
EPIODIC & REACTIVE ...

FUTURE: HEALTH DATA

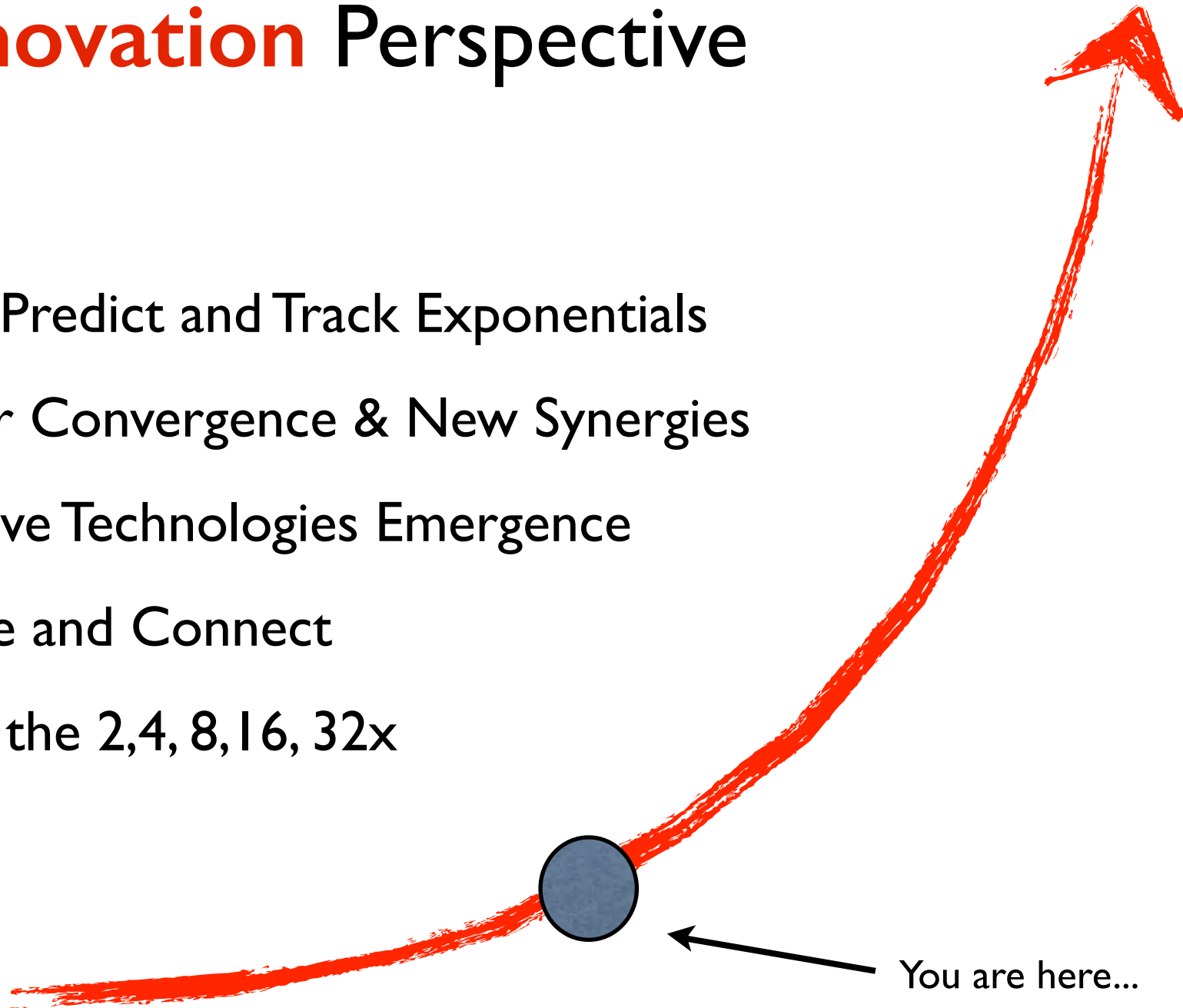


... when they need to be
CONTINUOUS & PROACTIVE



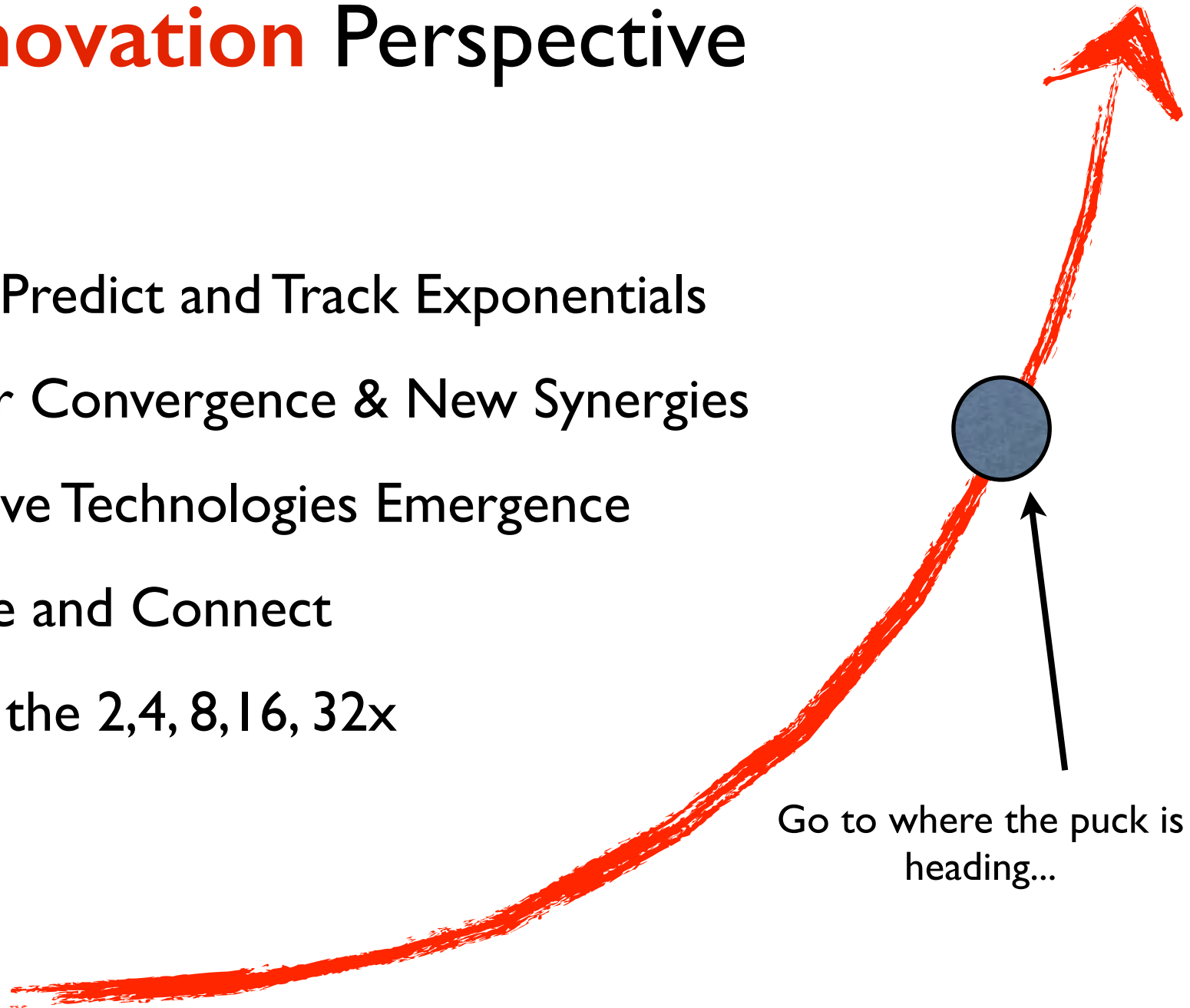
Innovation Perspective

- Identify, Predict and Track Exponentials
- Look for Convergence & New Synergies
- Disruptive Technologies Emergence
- Leverage and Connect
- Plan for the 2,4, 8, 16, 32x



Innovation Perspective

- Identify, Predict and Track Exponentials
- Look for Convergence & New Synergies
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- Plan for the 2,4, 8, 16, 32x



Go to where the puck is heading...

FAST MOVING, CONVERGENT TECHNOLOGIES



- **EMPOWERING THE PATIENT**
- **ENABLING THE CLINICIAN**
- **IMPROVE OUTCOMES, CLINICAL TRIALS**
- **COMPLIANCE, COMMUNICATION, FEEDBACK**
- **ENHANCING WELLNESS & IMPROVE Rx**
- **RE-IMAGINE PHARMA & REGULATORY**

THE FUTURE OF HEALTH



STAGE ZERO MEDICINE

The Future Is Already Here... Its Just Not Evenly Distributed...

William Gibson

The Best Way to Predict the Future...

Is to Create It... Alan Kay

Thanks



Contact Me: Daniel.Kraft@SingularityU.org



Follow me on Twitter:

[@daniel_kraft](https://twitter.com/daniel_kraft)

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- iMedicalApps.com